NOTE

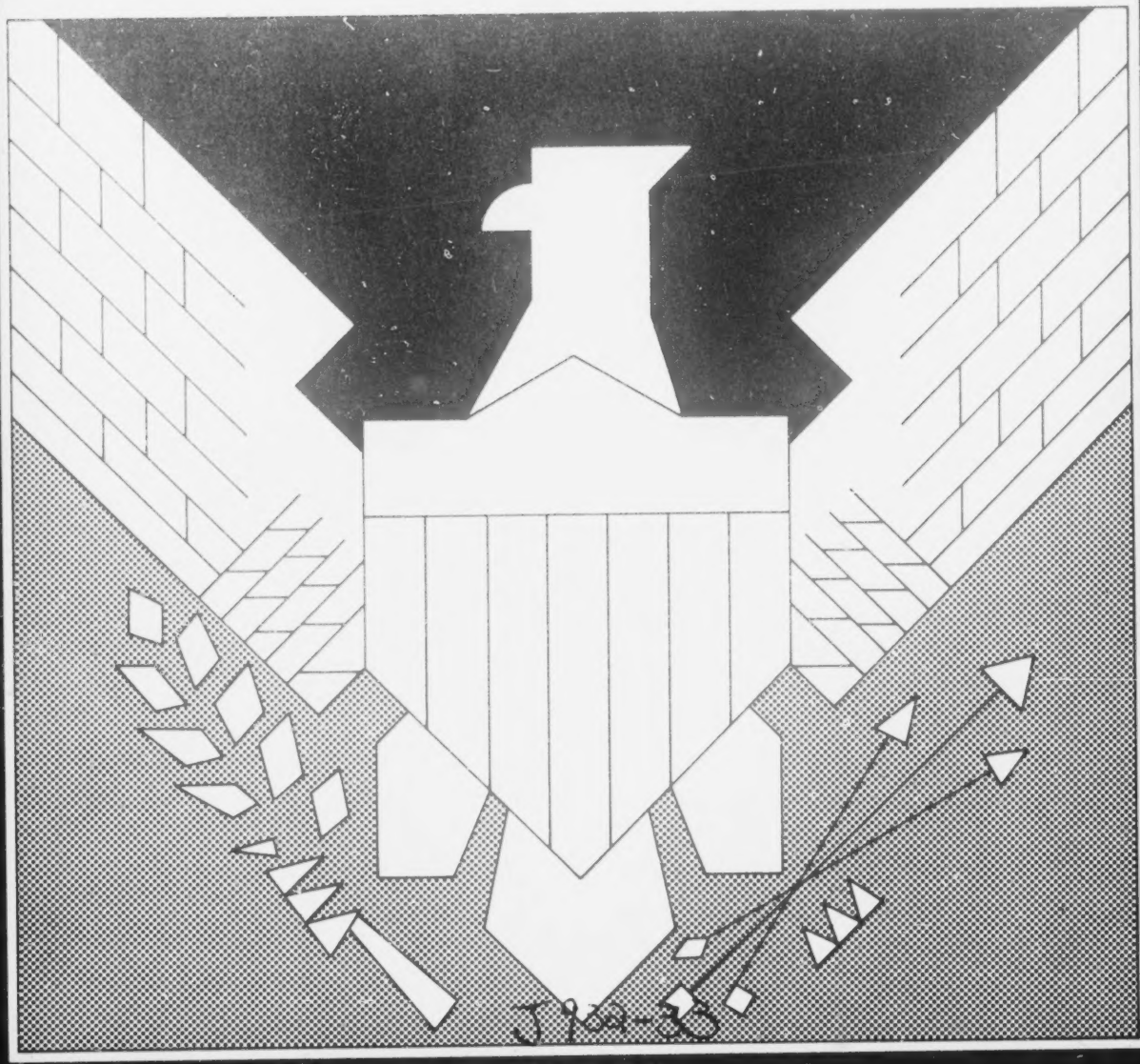
This Microfiche meets the quality requirements of the American National Standard for Microfiche of Documents (ANSI PH5.9-1975). However, because of imperfections in the document from which it was made, it contains images that are illegible or difficult to read. The source document for this microfiche is the best copy that could be obtained prior to filming.

CIS Congressional Information Service, Inc.
Washington, D.C.

CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

SEPTEMBER 1986

Improving Strategic Mobility: The C-17 Program and Alternatives



J 96a-33

CBO STUDY

IMPROVING STRATEGIC MOBILITY:

THE C-17 PROGRAM AND ALTERNATIVES

The Congress of the United States
Congressional Budget Office

NOTES

Unless otherwise specified, all costs are expressed in constant fiscal year 1987 budget authority dollars.

All dates, except those used in an historical context, refer to fiscal years.

Numbers in the tables of this report may not add to totals because of rounding.

PREFACE

In 1981, a Congressionally mandated study of mobility found that the United States lacked adequate means to transport troops and equipment overseas rapidly. Subsequently, the Administration initiated steps to improve U.S. airlift and sealift assets. A near-term improvement plan was approved by the Congress in 1983. In the fiscal year 1987 budget, the Administration has requested funds to begin production of the C-17 aircraft, intended to be the next generation of airlifter, replacing aging C-141s and C-130s. This analysis by the Congressional Budget Office (CBO) examines the Administration's plan to purchase the C-17 and compares it with alternative approaches to improving U.S. strategic mobility. The study was requested by the Senate Committee on Armed Services. In keeping with CBO's mandate to provide objective analysis, this report offers no recommendations.

R. William Thomas of CBO's National Security Division prepared the study under the general supervision of Robert F. Hale and John D. Mayer, Jr. William P. Myers of CBO's Budget Analysis Division performed the cost analysis. The author gratefully acknowledges the assistance of Steven Sheingold and Bonita J. Dombey of CBO and Martin J. Suydam, Jr. of the General Dynamics Corporation. (The assistance of an external reviewer implies no responsibility for the final product, which rests with CBO.) Paul L. Houts edited the manuscript, and G. William Darr prepared it for publication.

Rudolph G. Penner
Director

September 1986

CONTENTS

SUMMARY		ix
CHAPTER I	U.S. AIRLIFT: REQUIREMENTS VERSUS CAPABILITY	1
	Meeting Mobility Requirements and Goals	2
	Recent Improvements and Future Plans in Airlift	3
	Strategic and Tactical Aircraft Choices	4
CHAPTER II	THE ADMINISTRATION'S PLAN FOR AIRCRAFT IMPROVEMENTS	9
	Planned Changes in Force Structure	9
	Costs of the C-17 Program	16
CHAPTER III	ALTERNATIVE PROGRAMS TO IMPROVE STRATEGIC MOBILITY	23
	Alternative I: Achieve Airlift Goal Earlier	23
	Alternative II: Accept a Lower Airlift Goal	28
	Alternative III: Emphasize Maritime Prepositioning Instead of Airlift	33
	Summary of Cost Comparisons	39
APPENDIX A	DESCRIPTIONS OF TRANSPORT AIRCRAFT	43
APPENDIX B	SENSITIVITY ANALYSIS OF TOTAL AIRLIFT COST ESTIMATES	51

SUMMARY TABLE 1.	DESCRIPTION OF OPTIONS AND THEIR CAPABILITY	xi
SUMMARY TABLE 2.	COST OF OPTIONS	xiii
TABLE 1.	ADMINISTRATION'S AIRLIFT PLAN	10
TABLE 2.	THE C-17 AIRLIFT PROGRAM: ACQUISITION COSTS	17
TABLE 3.	OPERATION AND SUPPORT COSTS FOR VARIOUS AIRCRAFT	20
TABLE 4.	ACHIEVE AIRLIFT GOAL EARLIER: QUANTITIES AND ACQUISITION COSTS	26
TABLE 5.	ACCEPT A LOWER AIRLIFT GOAL: QUANTITIES AND ACQUISITION COSTS	34
TABLE 6.	EMPHASIZE MARITIME PREPOSITIONING: QUANTITIES AND ACQUISITION COSTS	38
TABLE 7.	SUMMARY OF COSTS FOR THE OPTIONS	40
TABLE A-1.	CHARACTERISTICS OF U.S. MILITARY AIRLIFT AIRCRAFT	44
TABLE A-2.	CHARACTERISTICS OF U.S. COMMERCIAL AIRCRAFT	49
TABLE B-1.	SENSITIVITY OF COST ESTIMATES TO THE DISCOUNT RATE	52
TABLE B-2.	SENSITIVITY OF COST ESTIMATES TO C-5 PEACETIME OPERATING RATE	53

SUMMARY FIGURE	INTERTHEATER AIRLIFT COMPARISON	xiv
FIGURE 1.	FISCAL YEAR 1989 AIRLIFT CAPABILITY	4
FIGURE 2.	U.S. AIRLIFT AIRCRAFT	5
FIGURE 3.	INTERTHEATER AIRLIFT CAPABILITY: ADMINISTRATION'S PLAN	12
FIGURE 4.	OPERATION AND SUPPORT COSTS PER AIRCRAFT	19
FIGURE 5.	INTERTHEATER AIRLIFT COMPARISON	24
FIGURE 6.	"SPECTRUM OF CONFLICT" APPROACH TO FORCE PLANNING	30
FIGURE 7.	INTERTHEATER AIRLIFT COMPARISON: LOWER AIRLIFT GOAL	32

SUMMARY

Strategic mobility is a critical element in U.S. military strategy. For political and economic reasons, the United States cannot maintain adequate forces abroad to meet all of its security commitments. Thus, it must be prepared to meet military aggression by rapidly deploying active and reserve units from their U.S. bases to the area where they are required, be it Europe, the Far East, Southwest Asia, or some unanticipated locale.

Strategic mobility is provided in three ways--airlift, sealift, and prepositioning. *Airlift* is used to move units to combat theaters rapidly. *Sealift*, which has historically moved over 95 percent of cargo during wars, will continue to meet most of the requirement to deploy heavily equipped forces, as well as provide most of the supplies to sustain combat once troops are in position. *Prepositioning* equipment and supplies means to place them in or near potential areas of conflict, thereby reducing the need to transport these items. Military or civilian aircraft would then move troops to the sites where their equipment is waiting.

In 1981, as a result of an overall review of mobility requirements, the Department of Defense (DoD) decided it should have the capability to move 66 million ton-miles per day (MTM/D) by air in the event of future military conflicts. This amount is the goal for strategic or intertheater aircraft that can move cargo over intercontinental distances. In 1983, as a first step to meet this goal, the Administration began to purchase 50 C-5B and 44 KC-10A aircraft. When the last of these aircraft are delivered in 1989, airlift capability will increase from 28.7 MTM/D in fiscal year 1983 to some 48.5 MTM/D, or 73 percent of the long-term goal of 66 MTM/D. The Administration plans to meet that goal by adding 210 new C-17 aircraft to the inventory by the year 2000. The C-17 aircraft offers new capability, but the program for it will require $29.3 billion in procurement and development costs. This Congressional Budget Office (CBO) study analyzes the Administration's plan for meeting mobility needs, with its emphasis on the C-17, and compares it with three alternative approaches that would use existing types of aircraft or ships.

THE ADMINISTRATION'S PLAN FOR STRATEGIC AIRLIFT

As the centerpiece of the Administration's plan, the C-17 would be a modern transport aircraft big enough to carry the largest U.S. military equip-

ment suitable for air transport a distance of 2,400 nautical miles. The Congress has been asked to provide long-lead funding for the first of these aircraft in the 1987 budget.

In addition to buying 210 C-17s, the Administration's plan would retire--and not replace--180 of the oldest C-130 aircraft. The short-range ("intratheater") capability thus lost would be replaced by a new capability of the C-17--namely, it has been designed to land on relatively short runways of 3,000 feet in length, thus permitting it to deliver equipment directly to airfields near the battle zone. For these reasons, the C-17 will modernize the intratheater airlift fleet as well as augment strategic airlift capability.

The Administration also intends to retire 54 existing C-141 transport aircraft and transfer another 80 C-141s to the reserves, reducing their monthly peacetime flying rate in order to extend their service lives (see Summary Table 1).

Effects on Capability

When coupled with the existing fleet and the near-term improvements now being completed, the Administration's plan would provide the United States with a strategic airlift capability equal to 66 MTM/D (for the first month of conflict) by about the year 2000. This capability would be a substantial increase over the 48.5 MTM/D that the near-term improvement program now under way will provide by fiscal year 1989.

In addition to providing strategic capability equal to 66 MTM/D, the Air Force argues that this option would effectively increase intratheater or short-range capability to 16,000 tons per day rather than the 9,000 tons per day available today. That improvement reflects an Air Force assumption that, in addition to the C-17's prime role as a long-distance or strategic airlifter, it would be able to fly cargo close to enemy lines and so augment intratheater capability.

The C-17 would be designed to provide a number of other qualitative improvements. Specifically, the Air Force believes the C-17 would:

- Increase deliveries at busy airfields because, compared with the C-5 aircraft now used for heavy equipment, its smaller size and greater maneuverability would avoid congestion;

- Minimize time spent loading and unloading by the innovations designed in its cargohold;

SUMMARY TABLE 1. DESCRIPTION OF OPTIONS AND THEIR CAPABILITY

Aircraft	Administration's Plan (Buy C-17)	Achieve Capability Earlier (C-5/KC-10)	Buy Less Airlift	Emphasize Prepositioning Instead of Airlift
		Description		
C-17A	210	0	0	0
C-5B	0	70	24	0
KC-10A	0	66	40	0
CRAF a/	10	31	31	0
C-141 Retirements	54	54	54	0
C-130 Retirements	180	180	180	180
C-130H Procurement	0	180	180	180
		Capability		
Strategic or Intertheater (MTM/D) b/	66	66	56	48.5
Year Accomplished	2000	1994	1991	1989
Intratheater (T/D) c/	16,000 d/	9,000	9,000	9,000

SOURCE: Congressional Budget Office.

a. Civil Reserve Air Fleet. The *Airlift Master Plan* would maintain 11.3 MTM/D in CRAF, which implies an addition of 10 wide-body, cargo-capable aircraft to the current fleet.
b. Million ton-miles per day. This widely used measure of capability combines the dimensions of cargo weight and the distance it can be moved in a day.
c. Tons per day.
d. Air Force estimate of the intratheater capability of the combined C-17/C-130 force.

- Reduce the number of required flight crew; its three crew members compare with an average of 5.5 for the C-141 and 6.5 for the C-5;
- Be more fuel-efficient than existing airlifters; and
- Reduce maintenance personnel and costs, thereby making it economical to operate in peacetime.

These are design goals, of course, and not always fully realized in practice. Most of them, however, are based on demonstrated technology. For instance, the engines for the C-17 are already in commercial service in the Boeing 757, and the advanced thrust reverser system was demonstrated in the YC-15 prototype developed in the late 1970s.

Costs

Over the next five years, the Administration's plan would result in investment costs of $10.1 billion. These added dollars would finish developing and begin buying the C-17 aircraft.

Costs over the next five years, however, are only part of the story. Purchase of the C-17 would continue through 1998 for a total investment of $29.3 billion. The United States would also operate the C-17 well into the next century. Thus, an estimate of the long-term operating costs of the C-17 and other aircraft involved in this option becomes important. To capture these effects, CBO has estimated costs to buy and operate the U.S. airlift fleet for the next 30 years. These costs were discounted at a real interest rate of 2 percent a year to be more comparable with current expenditures and are a reasonable guide to long-run costs. The 30-year costs to build and operate the airlift fleet under the Administration's plan amount to $118.1 billion (see Summary Table 2).

ALTERNATIVE I: ACHIEVE CAPABILITY EARLIER

The Administration's plan is not the only way to meet U.S. strategic airlift needs. Instead of developing and buying a new aircraft, the Air Force could continue buying the large C-5B transport and the KC-10 aircraft (a military version of the commercial DC-10), both of which are now in production. The Air Force could also meet some of its airlift requirements through additions to the Civil Reserve Air Fleet (CRAF)--a fleet of commercial aircraft that can be mobilized in a national emergency.

In analyzing Alternative I, CBO assumed the purchase of 70 more C-5B aircraft and 66 more KC-10s, and that 31 Boeing 747 aircraft (or their equivalent) would be added to the CRAF. In addition, to ensure adequate intratheater lift capability for this approach, CBO assumed the purchase of 180 more C-130H aircraft over the 1987-1998 period to replace the older-model C-130s that the Air Force intends to retire (see Summary Table 1).

Effects on Capability

Like the Administration's plan, Alternative I would provide 66 MTM/D of strategic lift capability for the first month of conflict. Indeed, because the C-5 and KC-10 are already in production, it would achieve this capability by 1994--six years sooner than the Administration's plan (see Summary Figure). Moreover, all the aircraft types to be purchased under this option are already operational. Thus, the risk of cost growth or failure to meet perform-

SUMMARY TABLE 2. COSTS OF OPTIONS
(In billions of 1987 dollars)

Option	Five-Year Costs		Thirty-Year Discounted Costs b/
	Investment a/	Total	
Administration Plan (Buy C-17)	10.1	31.0	118.1
Alternative I: Achieve Capability Earlier (Buy C-5/KC-10)	10.9	32.2	114.4
Alternative II: Buy Less Airlift	7.7	29.0	98.5
Alternative III: Emphasize Maritime Prepositioning Instead of Airlift	4.0	24.8	99.7

SOURCE: Congressional Budget Office.

a. Includes costs to develop and buy all new systems except the remaining C-5 and KC-10 aircraft included in the near-term program.
b. Discounted at a real rate of 2 percent a year.

ance goals is minimal. While the C-17 program shows no evidence to date of any significant technical problem, it is a new aircraft and so would present more risk of failure to achieve planned performance.

While the Administration's plan and Alternative I provide an equal amount of airlift capability, the C-17 would have a number of qualitative advantages--noted above--that the Air Force believes strongly favor choosing the new plane. In addition, Alternative I might not provide identical capability at shorter or intratheater distances. It would maintain shorter-range or intratheater lift at today's level of about 9,000 tons per day, whereas the Administration's plan would, according to the Air Force, raise that capability to about 16,000 tons per day.

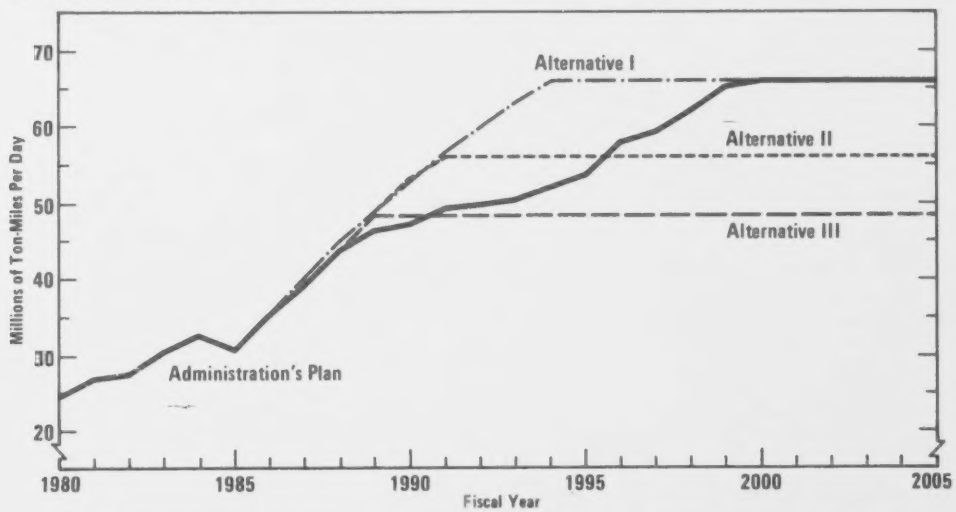
Despite these important differences, the two approaches are similar in their fundamental ability to move cargo long distances. For that reason, a comparison of their costs is revealing.

Costs

Over the next five years, Alternative I would require $0.8 billion more in investment than the Administration's plan, an increase of 8 percent (see

Summary Figure.

Intertheater Airlift Comparison



SOURCES: Congressional Budget Office (for 1987-2005 projections); Department of the Air Force (for 1980-1986 data).

Summary Table 2). This additional investment is needed because the C-5 and KC-10 aircraft are already in production. Thus, funding for additional aircraft must be provided quickly if their production lines are to remain active and efficient. Also, in contrast to the C-17 option, Alternative I would continue the purchase of substantial numbers of C-130 aircraft, which adds $1.5 billion to near-term investment costs.

Nonetheless, when examined in terms of total 30-year costs for acquisition, operation, and support of the airlift fleet, Alternative I is modestly cheaper than the C-17 option, saving $3.7 billion or 3 percent. It is less expensive in the long run because the lower costs of buying aircraft already in production more than offset the operating economies of the C-17. To maintain an adequate supply of trained pilots, however, it might be necessary to operate the C-5 at peacetime rates that are higher than those in current practice, thereby increasing total costs to $120.6 billion--$2.5 billion more than the cost for the C-17 approach.

CBO's comparative costs for the C-17 and the alternative C-5/KC-10 plan differ from the analysis presented by the Air Force in its 1983 study. The Air Force argued that the C-17 approach would be considerably cheaper in the long run. But the Air Force compared the costs of the C-17 with an "all C-5" alternative. CBO assumes that KC-10 and CRAF aircraft--cheaper to buy and operate--would be used to meet less demanding requirements for bulk cargo and "oversize" equipment, reserving the C-5s for heavy equipment. CBO also updated estimates for operation and support, which affected the relative cost of the two approaches, and discounted future costs, although doing so proved to be inconsequential.

ALTERNATIVE II: BUY LESS AIRLIFT

Both short- and long-run cost differences between the C-17 and the C-5/KC-10 approach are not large in percentage terms. If the Congress wishes to achieve large cost reductions, it will have to consider a smaller increase in the size of the strategic airlift fleet. To illustrate the costs of such a plan, CBO analyzed an alternative that would achieve 56 MTM/D rather than the DoD goal of 66 MTM/D for strategic airlift.

With the lower goal, it makes less sense to produce a new aircraft like the C-17. The fixed costs of completing its development and opening its production line would be spread over fewer aircraft, leading to a significant increase in unit cost. Thus, CBO assumed that the reduced goal of 56 MTM/D would be met by buying more C-5 and KC-10 aircraft and that the C-17 program would be canceled. Specifically, CBO assumed the purchase

of 24 additional C-5B aircraft and 40 KC-10 aircraft. Other changes in the airlift fleet are the same as those under the C-5/KC-10 option (Alternative I) discussed above.

Capability would gradually improve under this approach, but would level off at 56 MTM/D in 1991 rather than rising to 66 MTM/D. This lower capability would not meet estimated requirements in a major war, which often greatly exceed even the 66 MTM/D goal. Military commanders would also oppose the lower goal. On the other hand, 56 MTM/D would probably meet requirements in many lesser conflicts, which are also the most likely future wars. Moreover, 56 MTM/D would be a very large airlift capability by historical standards; the United States has never approached airlift capability of that amount in the past. Current military planning emphasizes the need to deploy forces quickly, with little warning time, across the globe. This objective drives airlift requirements to levels never before achieved by the United States.

Costs under Alternative II would, however, be substantially less in the long run. Over the next 30 years, discounted costs would be $19.6 billion or 17 percent less than under the Administration's plan.

Alternative II would also realize a reduction in investment cost over the next five years; over that time period, it would save $2.4 billion or about 24 percent, relative to the Administration's plan. Near-term costs, however, would still be substantial because, if any C-5 and KC-10 aircraft are to be bought, they must be bought soon while production lines are still open.

ALTERNATIVE III: EMPHASIZE MARITIME PREPOSITIONING INSTEAD OF AIRLIFT

If near-term costs are the major issue, the Congress could decide not to make further improvements in U.S. strategic airlift capabilities beyond 1989. Instead, it could make improvements in U.S. prepositioning.

Specifically, Alternative III would cancel the C-17 program and keep airlift capability at 48.5 MTM/D. It would instead place the equipment for an Army mechanized division aboard 12 large maritime prepositioning ships. Moreover, because some equipment and supplies might need to be moved to forward positions by air, this option would also acquire 180 additional C-130 aircraft to maintain intratheater airlift capability at the 9,000 tons per day level currently available.

The effects on costs of substituting these 12 ships for additional strategic airlift would be substantial. Maritime prepositioning ships have been

acquired in the past through a lease/charter arrangement. Five-year costs --covering the lease of needed prepositioning ships and the purchase of C-130 aircraft as well as the acquisition of some of the mechanized division equipment--would equal $4.0 billion, which is 60 percent less than the cost of the Administration's plan. As the ships become available, equipment to be prepositioned aboard them could be taken from other uses. Eventually, the prepositioned equipment would have to be replaced. But the 30-year discounted costs of Alternative III, which include the purchase of all extra equipment, as well as full lease costs, would equal $99.7 billion--or 16 percent below those of the Air Force plan.

Substituting maritime prepositioning for airlift does not, of course, provide equal capability even if the two modes of mobility move the same number of tons in the same overall period of time. Prepositioning ships take longer to get *initial* deliveries to their final destination than aircraft, which can fly high-priority cargo to a spot quickly. But prepositioning may result in faster delivery of the entire division. Indeed, it would take the entire planned C-17 fleet about 18 days to move a mechanized division from the United States to Southwest Asia. By then, a prepositioned division would be in combat deployment. On the other hand, ships cannot go where aircraft can--and this may limit U.S. options. Current tactical aircraft are of little use in deploying forces since they are unable to carry outsize equipment. A prepositioning strategy also requires that planners correctly anticipate where equipment will be needed well in advance of hostilities. Nonetheless, Alternative III illustrates the major cost advantage of prepositioning duplicate equipment rather than buying aircraft to move it.

CONCLUSION

According to CBO's analysis, if the 66 MTM/D goal is to be attained, the differences in costs between the C-17 option and the C-5/KC-10 option are not large. The long-run savings from the latter are at best about 3 percent of costs, well within the range of uncertainty for such long-range projections. The choice between these two approaches probably turns on the qualitative advantages of the C-17's new design versus the more rapid improvements in capability offered by the C-5/KC-10 approach.

Neither of these airlift approaches, however, would greatly reduce spending over the next five years. These costs can only be avoided if the Congress considers--as either a temporary or permanent solution--deferring airlift improvements and relying more on sealift or prepositioning as a cheaper way to position U.S. military forces.

CHAPTER I

U.S. AIRLIFT: REQUIREMENTS VERSUS CAPABILITY

To meet its worldwide security commitments, the United States needs strategic mobility--namely, the ability to move military forces rapidly from their U.S. bases to potential trouble spots around the world and to support these forces once they are deployed. The Air Force and the Navy provide mobility forces, primarily to support the Army and the Marines. Resources to buy transport aircraft and ships, however, must compete directly with resources for modern combat aircraft and ships. When resources were limited, as they were in the 1970s, funds for strategic mobility became especially scarce. Indeed, until the fiscal year 1983 budget, strategic mobility had not fared at all well in competing with other military missions for available budgetary resources.

As a result, in recent years a general consensus developed that the United States lacked the means to deploy large numbers of combat forces rapidly. During World War II, Korea, and Vietnam, over 95 percent of U.S. forces and supplies moved by sea. But the U.S.-flag dry cargo fleet has declined from over 600 ships in 1970 to about 265 in 1983. 1/ This number represents a decline in total ship tonnage of about 50 percent.

At the same time as this decline was taking place, the United States was identifying new parts of the world that it viewed as critical to its national interests. In addition to its long-standing commitments to the defense of Europe and its allies in the Far East, the United States was assuming additional security responsibilities in Southwest Asia and Latin America. In light of these new commitments, the Congress believed a growing imbalance was developing between defense requirements and capability for strategic mobility. For example, in 1980 when President Carter announced the Carter Doctrine committing the United States to protect the Persian Gulf with military forces if necessary, the United States had sufficient airlift to deploy only about a third of the equipment and material that the military believed would be needed to repulse a threat to the Gulf States' oil fields.

---

1. Strategic Sealift Division, Office of the Chief of Naval Operations, *Strategic Sealift Program Information* (Washington, D.C.: Department of the Navy, April 1985), p. 12.

MEETING MOBILITY REQUIREMENTS AND GOALS

Over the past years, serious concerns about U.S. mobility have prompted a series of studies and actions. In 1981, at the request of the Congress, the Department of Defense (DoD) performed an analysis of mobility requirements and current capabilities--the *Congressionally Mandated Mobility Study* (CMMS). 2/ This study looked at mobility requirements for a number of contingencies, including a major conflict in Southwest Asia and the rapid reinforcement of NATO in the event of war in Europe. As a result of the study, the Department of Defense recommended increasing U.S. mobility by adding to all three means of mobility: airlift capability, sealift capability, and prepositioning of equipment and supplies where they might be needed.

These three methods, however, do not contribute equally to mobility. Sealift would continue to provide about 95 percent of all mobility necessary for the bulk of equipment and to sustain forces in any future major conflict. But ships are slow, requiring two to four weeks to make deliveries, depending on the destination. Therefore, they cannot provide the prompt response that might be necessary in many possible situations. While prepositioning of equipment and supplies, either on land or in special ships, can speed deployment, it limits flexibility by committing forces to certain theaters and requires buying duplicate sets of equipment for forces.

Airlift remains the most flexible and responsive way to provide the mobility that would be needed for immediate wartime response. Transport aircraft can deliver forces quickly anywhere in the world. But airlift is expensive; each C-17 will cost $142 million. Moreover, it would take nearly 230 C-17 sorties to move the same amount of cargo that a single $200 million ship can carry. Military planners, therefore, have never considered buying an airlift fleet to handle more than a small fraction of U.S. mobility needs. Hence, requirements for airlift to distant areas such as Southwest Asia are calculated based on the need to deploy relatively light Army and Marine units--together with supporting tactical aircraft and air defense systems--to slow enemy advances, seize strongpoints and airfields, and establish beachheads. This deployment of light units would allow time for heavier units and supplies to arrive by sea. In the event of a European conflict, airlift would transport troops and essential equipment to augment forward deployed and prepositioned forces.

---

2. Department of Defense, *Congressionally Mandated Mobility Study* (U), SECRET (Washington, D.C.: DoD, 1981).

The CMMS study found that U.S. airlift capability was far from adequate to meet the requirements of a major conflict in either Europe or Southwest Asia. The study recommended that the United States more than double the capability of its 1981 airlift fleet, raising the capability from about 27 million ton-miles per day (MTM/D) to a goal of 66 MTM/D. 3/ The Department of Defense (DoD) adopted this goal, and the oversight committees of the Congress generally accepted it as the target for efforts to improve airlift. Nevertheless, the military services do not believe this goal of 66 MTM/D would meet the full requirements for airlift in a major conflict involving the Soviet Union; instead, they claim, the figure is a compromise between meeting requirements fully and holding down costs.

RECENT IMPROVEMENTS AND FUTURE PLANS IN AIRLIFT

As a step toward meeting the 66 MTM/D goal, the Administration proposed a near-term airlift improvement program in the 1983 budget. The program included the acquisition of 50 C-5B and 44 KC-10A aircraft; it also called for enhancing the Civil Reserve Air Fleet (CRAF)--commercial aircraft that have been modified so they can be converted rapidly to military cargo operations in an emergency. In 1983, the Air Force estimated that the addition of these new aircraft, coupled with higher levels of support for existing aircraft, would increase airlift capability to 48.5 MTM/D--or about three-fourths of the long-term goal--by 1988 (see Figure 1). 4/

Airlift Master Plan

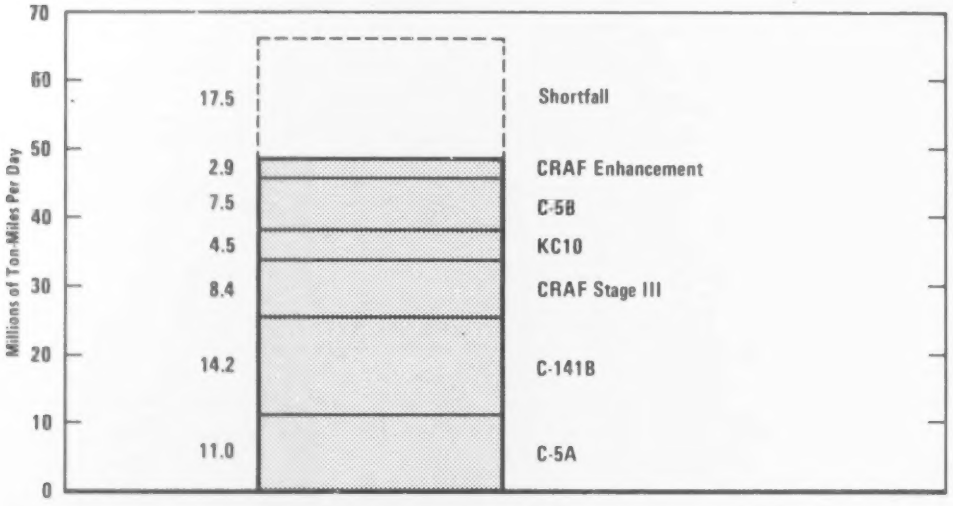
Before deciding how to meet the remainder of the goal, the Congress directed the Air Force to develop a plan for employing existing aircraft and to evaluate alternatives for increasing airlift capability. The *Airlift Master Plan*, released in 1983, was the Air Force's response. 5/ The plan specifically revalidated the Air Force's choice of the C-17--a new, large transport aircraft designed by the McDonnell Douglas Corporation--as the next-generation of strategic airlifter. The Air Force had originally selected the

3. Ton-miles per day is a common measure that reflects the amount of cargo to be moved, the distance it must travel, and the time period required to complete the deployment. Capability of the airlift fleet (in ton-miles per day) is calculated based on the payload, speed, and utilization rate for each type of aircraft and the number of aircraft available.

4. Revisions of wartime planning factors reduce the Air Force's estimate of capability provided by the near-term program to 45.4 MTM/D by 1989.

5. Department of the Air Force, *Airlift Master Plan* (September 1983).

Figure 1.
Fiscal Year 1989 Airlift Capability



SOURCE: Department of the Air Force, *Airlift Master Plan* (September 1983), p. III-13.

C-17 in 1981 as the eventual replacement for the C-141B aircraft, which was built between 1964 and 1968 and today represents the majority of aircraft in the military airlift fleet.

While strongly supported by the Administration, the Air Force's plan to acquire 210 C-17s has been criticized. 6/ For one thing, it will be an expensive aircraft; total procurement, research and development, and military construction costs will amount to $30 billion, or about $142 million per plane. Furthermore, because the C-17 is a new aircraft that has never been produced, procurement will take many years. In fact, the goal of 66 MTM/D of strategic airlift capability will not be achieved until the year 2000, about 20 years after the need for it was established.

STRATEGIC AND TACTICAL AIRCRAFT CHOICES

The Congress could elect not to continue the C-17 program and, instead, pursue other improvements in airlift or mobility. For example, the goal of

6. Jeffrey Record, "U.S. Strategic Airlift: Requirements and Capabilities," *National Security Paper: 2* (Washington, D.C.: Institute for Foreign Policy Analysis, 1986) and Kim R. Holmes, "Closing the Military Airlift Gap" (Washington, D.C.: Heritage Foundation, 1986).

66 MTM/D could be achieved more quickly, and at a comparable cost, by buying aircraft now in production, such as the C-5 or KC-10, rather than a newly designed plane. Other analysts have noted that maritime prepositioning, while not as responsive as airlift, is dramatically cheaper.

Each of these possible choices has advantages and disadvantages. The Administration believes the C-17 to be the best choice. Yet, the Administration's plan involves important changes in force structure involving other airlift aircraft and derives much of its savings from these aircraft.

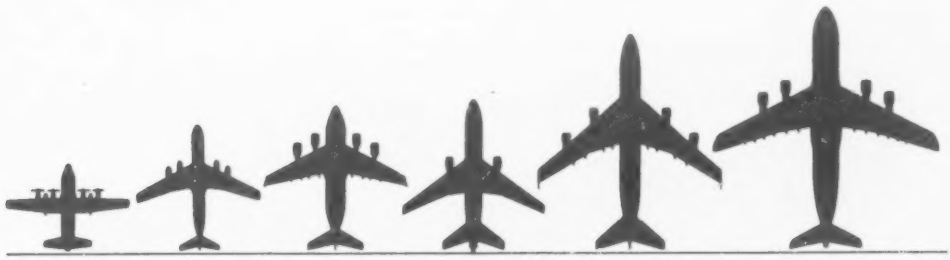
To provide a better understanding of these options, the following paragraphs offer brief descriptions of the C-17 and other major aircraft in the U.S. airlift fleet. (See Figure 2. For a more detailed overview, the reader should also consult Appendix A.)

McDonnell Douglas C-17

The C-17 aircraft has been designed to fill both strategic and tactical airlift roles. It will be capable of delivering major equipment directly from U.S. bases to forward areas, thus offering the potential of eliminating the time-consuming transshipment stage.

In its strategic airlift role, the C-17 will be able to transport "outsize" pieces of equipment, such as the M1 tank or the Bradley Fighting Vehicle, over intercontinental distances. Today, only the Lockheed C-5 Galaxy

Figure 2.
U.S. Airlift Aircraft



SOURCE: Department of the Air Force.

(described below) has the ability to move these items. The C-17 will also be able to carry relatively smaller equipment, such as towed howitzers or trucks (referred to as "oversize" equipment), as well as bulk cargo, such as rations or ammunition.

In its tactical airlift role, the C-17's design incorporates special military capabilities such as the low altitude parachute extraction system--which allows cargo to be extracted from the aircraft without the aircraft actually landing--and the combat offload technique--which allows the cargo aboard the aircraft to be unloaded without the aircraft coming to a full stop after it lands.

At its present stage of development, the C-17 aircraft appears capable of meeting (and in some cases, exceeding) its design requirements. In addition, the manufacturer will guarantee many of the aircraft specifications, such as the reliability and maintainability standards, the structural integrity of the airframe and components, and the takeoff and landing performance. The C-17 also requires a minimal crew--pilot, copilot, and loadmaster. But such capabilities are not purchased cheaply. The total cost of each C-17 is currently estimated to average $142 million.

Lockheed C-5B Galaxy

One alternative for the Congress is to continue buying the C-5B. The largest aircraft operated by the Military Airlift Command (MAC), it has somewhat greater intertheater capability than the C-17 but, according to the Air Force, is more limited in the intratheater role. Like the C-17, it can carry such outsize cargo as tanks. Indeed, one C-5 can transport two M1 tanks (the C-17 can carry only one) or six Bradley Fighting Vehicles.

Seventy-seven of the C-5A aircraft, built between 1969 and 1973, remain in service with MAC. Acquisition of an additional 50 C-5B aircraft, which was authorized in 1982, will be completed in 1989. The 50 C-5Bs currently being procured cost an average of $168 million each (in 1987 budget year dollars). The Lockheed Corporation in January 1986 offered to sell the Air Force 24 additional aircraft at an average flyaway price of $90 million (in constant 1984 dollars). Based on this offer, CBO estimates that the unit program cost for the C-5, including initial spares and other support equipment, would be about $125 million (in 1987 budget year dollars).

McDonnell Douglas KC-10A Cargo/Tanker Aircraft

Another alternative currently available is the KC-10A. The KC-10A is a military version of the commercial DC-10 aircraft. It is a three-engine

widebodied transport that can be operated either as a tanker for aerial refueling or as a cargo aircraft. Currently, all KC-10s are operated by the Strategic Air Command as tankers.

The KC-10A cannot carry outsize equipment such as tanks and helicopters. Moreover, the cargo door, which is high on the side of the aircraft, limits its usefulness as a military transport, since specialized unloading equipment is required at the destination. Thus, the KC-10s are best suited to hauling bulk and certain oversize cargo to main operating bases. In this role, however, the aircraft is effective; it can transport up to 170,000 pounds of cargo (or 27 standard military pallets) up to 3,800 nautical miles. The KC-10As being acquired in 1987 cost about $63 million each, considerably less than the C-17 or the C-5B.

Civil Reserve Air Fleet Aircraft

Yet another approach to meeting airlift needs would emphasize increasing the size of the Civil Reserve Air Fleet (CRAF). In an emergency, commercial aircraft operated by carriers that belong to the CRAF would be available to transport military cargo. 7/ These aircraft include all-cargo or cargo-convertible versions of the Boeing 707 and 747, and the McDonnell Douglas DC-8 and DC-10. 8/ The Administration's CRAF Enhancement Program is currently adding 19 wide-bodied aircraft to the CRAF cargo fleet by paying for modifications to allow passenger aircraft to be converted rapidly to cargo operation.

While CRAF aircraft would be critically needed in a major war as carriers of bulk material and people, their capabilities are seriously limited. To be carried by these aircraft, equipment must be loaded on pallets. None of the aircraft can carry outsize cargo, and only the 747 and the DC-10 can carry oversize cargo. Also, none of these CRAF aircraft is air-refuelable. Thus, their operation to remote areas could be restricted by another country's refusal of landing or overflight rights.

---

7. The CRAF program also includes over 200 commercial passenger aircraft that would be used to transport troops to combat theaters.

8. These aircraft are capable of long-distance international cargo missions. Other aircraft, such as the Boeing 727 and 737 and the McDonnell Douglas DC-9, also belong to the CRAF cargo program and would be used for domestic or short-distance international missions in an emergency.

63-666 O - 86 - 2

CHAPTER II

THE ADMINISTRATION'S PLAN FOR AIRLIFT IMPROVEMENTS

To meet the goal of 66 million ton-miles per day (MTM/D) of intertheater airlift capability, the Administration plans a significant expansion of its airlift forces. It intends to finish developing and buy 210 new C-17 aircraft over the 1988-1998 period, at a cost of $29.3 billion. In addition to acquiring the C-17, the Administration intends to make a number of other significant changes in force structure that would affect the active and reserve forces as well as the cost of the airlift program.

PLANNED CHANGES IN FORCE STRUCTURE

As a result of the near-term airlift improvement program approved by the Congress in 1983, the Air Force's strategic airlift forces will, by 1989, include 66 C-5As, 44 C-5Bs, 57 KC-10As, and 234 C-141Bs (see Table 1). 1/ In addition, some 500 C-130 tactical airlifters are now available in active, Air National Guard, and Air Force Reserve squadrons.

Changes in Aircraft

To arrive at the planned force structure for the year 2000, the Administration contemplates major changes in airlift forces. Although it plans no further purchases of C-5Bs or KC-10s after 1987, it will add 180 new C-17s to the force structure by the year 2000. 2/ These C-17s will serve as the backbone of the military airlift operating fleet, replacing the C-141 in that role by the end of the next decade. Fifty-four older C-141s will be retired,

---

1. These counts are based on primary aircraft authorized (PAA), and exclude backup and trainer aircraft. From the total force of 77 C-5A aircraft, for example, it is estimated that 66 will be available at any given time to perform the airlift mission. The Air Force determines the total number of aircraft to be acquired based on the number necessary to support primary missions and those necessary for training and backup inventory.

2. Of the 210 aircraft, 30 are for training and backup inventory. Thus, the number of primary aircraft available to perform airlift missions is 180.

TABLE 1. ADMINISTRATION'S AIRLIFT PLAN (In terms of primary aircraft authorized)

	Fiscal Year 1989 Forces			Planned Force Structure Changes, 1989-2000		Fiscal Year 2000 Forces		
	Active	Reserve	Total	Add or Retire	Transfer to Reserves	Active	Reserve	Total
Strategic Airlifters								
C-5A/B	70	40	110	0	0	70	40	110
C-141B	218	16	234	-54	64	100	80	180
KC-10	57	0	57	0	0	57	0	57
C-17	0	0	0	180	48	132	48	180
Total	345	56	401	126	112	359	168	527
Tactical Airlifters								
C-130A/B/E/H	202	300	502	-160 a/	0	190	152	342
Total Aircraft	547	356	903	-34	112	549	320	869

SOURCE: Department of the Air Force, *Airlift Total Force Plan* (Washington, D.C.: Department of the Air Force, September 1984); supplementary data also supplied by the Department of the Air Force.

NOTE: All data are for primary aircraft authorized and exclude trainer and backup aircraft.

a. Approximately 20 of the total planned 180 C-130 retirements will have been made by 1989.

and the peacetime operating rate of the remaining 180 of these aircraft will be reduced by 50 percent.

This reduction in peacetime operations of the C-141s will be achieved by assigning only two crews per plane versus the current four crews. It will also allow the C-141 aircraft to continue in the force until about the year 2010 without exceeding their 45,000 flying hour estimated service life. Thus, by the year 2000, the strategic airlift force would gain 180 new and more capable aircraft, lose 54 considerably older and less capable aircraft, and thereby have a net increase in airlift capability of 36 percent.

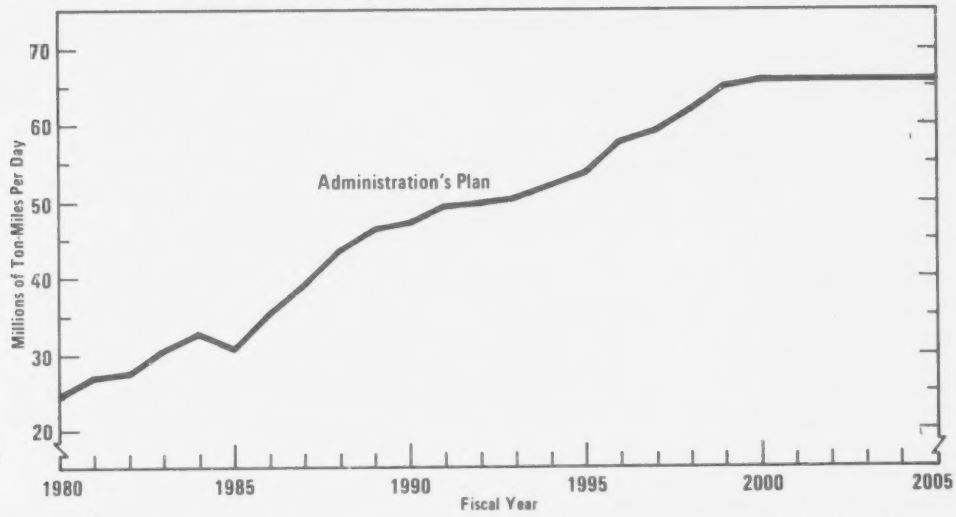
In addition, the Administration's plan would reduce the number of tactical aircraft, which are designed to carry cargo over relatively short distances within a given combat theater. The Administration plans to retire 180 of the oldest C-130 tactical airlifters, which are considerably less capable and more expensive to maintain than the newer C-130E and C-130H models. The retirement of these airlifters would reduce the C-130 fleet by about one-third, to 324 aircraft. According to the Administration, this loss in tactical airlift capability would be offset by the ability of the C-17 to deliver equipment directly to forward operating areas, thereby helping to meet tactical airlift requirements. Other analysts have noted, however, that having a fewer number of tactical aircraft may limit the flexibility of theater commanders.

Transfer of Equipment and Missions to the Reserve Forces

Traditionally, airlift squadrons in the part-time air reserve forces (the Air National Guard and Air Force Reserve) have had only tactical aircraft--primarily C-130s, as well as smaller numbers of other aircraft. The planned one-third reduction in C-130 forces would eliminate many tactical squadrons, mostly those manned by reservists.

To offset the reduction, the Air Force has initiated a program of transferring aircraft to the reserve forces, who will assume new responsibilities for strategic airlift. Forty (PAA) C-5A aircraft will be transferred by 1989, as will 16 (of an eventual 80) C-141B aircraft. In addition, 48 of the 180 (PAA) C-17s will go directly to air reserve forces, so that by the year 2000 all three types of strategic airlifters will be present in the reserve forces' inventory. Reserve associate squadrons, in which reservists share responsibility for operating and maintaining equipment belonging to an active squadron, will continue to share equipment with active C-5 and KC-10 squadrons, and some C-17 squadrons. These shifts affect both capability and costs.

Figure 3.
Intertheater Airlift Capability: The Administration's Plan



SOURCES: Congressional Budget Office (for 1987-2005 projections); Department of the Air Force (for 1980-1986 data).

Quantitative Improvements in Airlift Capability

The Administration's plan will generate a gradual improvement in airlift capability, probably reaching the 66 MTM/D goal for intertheater airlift by the year 2000 (see Figure 3). The Air Force, however, is modifying some of the factors that determine estimates of airlift capability, and such changes could alter these results. In addition to increasing intertheater capability, the Administration's plan will also improve intratheater or tactical airlift capability.

Improvements in Capability

The Air Force currently estimates intertheater airlift capability to be about 35 MTM/D. By 1989, when all the C-5Bs and KC-10s will have been delivered, capability will increase to 48.5 MTM/D. 3/ The 180 new C-17s would add 27.4 MTM/D of intertheater capability to this base, which would actually raise capability to some 76 MTM/D if other changes were not planned.

---

3. The estimate of 48.5 MTM/D is based on a 12.5 hours per day utilization rate for military airlifters and 10 hours per day for CRAF aircraft.

The Administration's plan to retire the 54 C-141B aircraft, together with the 50 percent reduction in crews for the remaining 180 C-141B aircraft, will reduce the contribution of these aircraft to total airlift capability by about 10 MTM/D. Thus, the net gain just meets the 66 MTM/D goal.

Uncertainties in Intertheater Estimates. The 66 MTM/D is an estimate that depends on numerous planning factors. The Air Force is currently modifying those factors in ways that mean that the Administration's plan may not fully meet the 66 MTM/D goal.

Actual wartime airlift capability is uncertain. As is often true of wartime planning, estimates depend on a combination of facts and assumptions. Planners distinguish between "surge capability"--the amount of airlift a force can generate during the initial days of intense mobilization activity --and "sustained capability"--the amount of airlift activity sustainable in the longer term. The 66 MTM/D goal is for surge capability, which includes the major deployment of units and their equipment from the United States to combat theaters. Surge capability is higher than sustained capability because planners assume that both machines and their crews can operate at higher rates for a short period by deferring routine maintenance and crew time-off until the emergency is past. The focus of this study is on surge capability, which is the critical factor for airlift planning.

Capability estimates for an aircraft depend on a number of factors, including:

- Cargo capacity (floor space, volume, and weight);
- Mix of cargo being carried, whether it is dense cargo (like ammunition) or relatively light equipment requiring a large floor area;
- Speed of the aircraft;
- Utilization rate (a fleetwide average of the number of flying hours per day it can generate);
- Availability of spare parts and maintenance facilities; and
- Number of flight crews assigned per plane.

The first four factors--size, cargo mix, speed, and utilization rate--are usually combined to determine the highest feasible aircraft productivity in ton-

miles per day. Thus, a C-5B carrying an average of 69 tons at a speed of 423 nautical miles per hour and flying 12.5 hours per day generates 171,000 ton-miles per day of capability. The 12.5 hours per day is labeled the "objective rate" and is the figure used for force planning. This rate would be reduced if the supply of spare parts was inadequate to sustain it, if maintenance personnel or facilities were limited, or if the number of trained flight crews were insufficient. For example, four separate crews, or a total of 26 personnel, are estimated to be needed per C-5B to maintain operations at the 12.5 hours per day rate during the surge period.

The most controversial factor in estimating capability is the wartime objective utilization rate--the number of hours per day the aircraft can fly. Before 1974, the rate was simply set at 10 hours per day for planning purposes, and the requirements for crew, maintenance, and parts were computed based on that assumption. In 1974, Secretary of Defense Schlesinger directed the Air Force to raise the rate to 12.5 hours per day, thereby raising total airlift capability by 25 percent without buying one new aircraft. As a result, crews and maintenance personnel had to be increased to sustain the higher figure. Utilization rates for the C-5A/B, the C-141, and the KC-10 in this study, as well as the Air Force's *Airlift Master Plan*, adopt this figure of 12.5 hours per day.

The productivity of the C-17, however, is calculated by the Air Force based on an average rate of 15.65 hours per day of operation. The Air Force bases this higher rate on the low maintenance man-hours per flight hour specified in the C-17 contract. It also believes that special features of the new aircraft--such as its advanced thrust reverser, which allows the plane to unload in a crowded area--will expedite loading and unloading the aircraft, thereby limiting time spent on the ground.

While this productivity rate is higher than any previous rate used by the Air Force in airlift planning, the 15.65 figure is comparable to the best rates achieved by some commercial airlines in long-haul cargo operations. 4/ It is uncertain, however, whether this rate could be achieved under wartime conditions, and to what extent it would be reduced by making deliveries to forward areas.

The Air Force and the Department of Defense have performed analytic simulations of deployment, based on the actual units and cargo loads that would be delivered by air in a crisis. These studies suggest that the objec-

---

4. During the Vietnam War, several commercial carriers achieved such rates not just for a month but for over a year of operations. This information is based on airline operating statistics compiled by the McDonnell Douglas Corporation.

tive rates used for both the C-17 and other aircraft might be too high. In fact, in part because of these findings, the Air Force has already lowered its objective rate for the C-5 from 12.5 to 11.0 hours per day. In its forthcoming review of airlift needs, the Air Force may also reduce the planned utilization rate for the C-17.

Reductions in utilization rates will mean that, in the absence of any offsetting changes, the Administration's plan will not meet the goal of 66 MTM/D. Eventually, that could mean that the Air Force will need to procure more than 210 C-17 aircraft. On the other hand, other changes in factors could offset these reductions in utilization rates. Changes in utilization rates could also alter the relative effectiveness of the C-17 when compared with alternatives like the C-5. (See Chapter III for a discussion of these issues.)

Uncertainties in Intratheater Capability. The current tactical airlift fleet is capable of delivering some 9,000 tons of cargo per day, according to assumptions used in the *Airlift Master Plan*. Retiring 180 C-130s without replacing them would reduce this figure by one-third. The Administration, however, argues that the direct-delivery capability of the C-17--the ability to deliver cargo to small airfields--will effectively raise total intratheater airlift capability to 16,000 tons per day. 5/

Calculations leading to this figure, however, are questionable. In particular, when calculating the C-17's intratheater capability, the Air Force assumes the same tonnage as for intertheater missions. This assumption, however, may overstate its contribution, since much of the C-17's cargo space might be wasted in tactical missions. Combat experience in Vietnam suggests that tactical airlift missions involved relatively small, though high priority, payloads. On the other hand, one can argue that, since no aircraft with the C-17's combination of payload and performance was available in Vietnam, generalizations from that experience are of limited value in planning for the use of tactical airlifters in the event of any future conflicts.

Qualitative Improvements

The C-17 would also provide qualitative improvements that the Air Force believes are as important as its quantitative contributions. As was noted in Chapter I, the C-17 combines the heavy lift capability of a long-range transport with a tactical ability to deliver cargo to forward areas. It also

5. Department of the Air Force, *Airlift Master Plan*, p. V-9.

needs only a minimal crew and, assuming the aircraft performs to specifications, will achieve better reliability and require less maintenance than existing strategic airlift aircraft.

COSTS OF THE C-17 PROGRAM

The C-17 program requires careful consideration of both near-term and long-term costs.

Near-Term Costs

Funding for the C-17 in the five-year defense program is substantial. Over the next five years, the Administration expects to request $10.1 billion in constant 1987 budget dollars (see Table 2). This total includes $2.9 billion for continued development and testing of the aircraft and $7.1 billion to procure the first 22 aircraft, starting in 1988. Also, CBO estimates about $0.1 billion will be required to add four aircraft to the CRAF program.

This spending, about $2 billion to $3 billion per year, would continue the higher level of support for airlift begun in 1983 with Congressional approval of the near-term airlift improvement program. The funds for airlift in the 1987 budget request, for example, are $2.9 billion, of which $2 billion is to complete the C-5B program, $0.1 billion is the final payment on the KC-10 acquisition, and the remaining $0.8 billion is for long-lead procurement and continued development of the C-17.

Total Program and Unit Costs

Near-term costs are only part of the C-17 financial story. The cost to complete the C-17 program is currently estimated at $29.3 billion (see Table 2). Total program costs are $29.9 billion or $142 million for each aircraft. Moreover, the Air Force estimates that flyaway cost (which excludes research and development funds, initial spares, training equipment, ground support equipment, and other nonaircraft costs) will average $103 million per plane. This latter figure compares with current flyaway costs of $63 million for the KC-10 and $108 million for the C-5B.

Long-Term Costs of the Administration's Plan

Although near-term costs are important, long-term costs cannot be ignored when considering airlift. After all, aircraft procured today will probably

TABLE 2. THE C-17 AIRLIFT PROGRAM: ACQUISITION COSTS
(By fiscal year, in billions of 1987 budget year dollars)

Category	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Program
Research and Development	0.6	0.9	0.7	0.4	0.3	2.9	0.3	3.2
Procurement	0.2	1.3	1.2	1.8	2.5	7.1	18.8	25.9
Total Cost	0.8	2.2	1.9	2.2	2.8	10.0	19.3 a/	29.3 a/

SOURCE: Congressional Budget Office from Department of Defense Selected Acquisition Reports.

a. Includes $158 million in military construction costs not shown separately. Excludes about $660 million for research and development done before 1987.

still be operating 30 to 40 years from now. Long-term costs of people, repairs, and daily operations are greater than acquisition costs. Indeed, according to the Air Force, operating savings would more than offset the high initial price paid for the C-17.

Defining Life-Cycle Costs. CBO based its long-term cost comparisons on total life-cycle costs, which combine acquisition and operating costs for the entire airlift fleet over the next 30 years. Acquisition costs for the various aircraft have already been noted. There are, however, numerous issues regarding operating and support costs.

Operation and support (O&S) costs per aircraft are the costs attributed to maintaining a squadron of each type of aircraft in peacetime divided by the squadron size. 6/ They include the pay for all military and civilian personnel assigned to the squadron, maintenance and repair costs (including depot maintenance as well as on-base maintenance), spare parts, and the cost of fuel for flying operations. The costs for military and civilian benefits, including accrual of retired pay, are added to direct military pay. Personnel costs for an airlift squadron include all people assigned to the squadron, including staff, security, and medical personnel, but they do not include any allocation of costs for higher administrative levels, such as Wing Headquarters, Headquarters, Military Airlift Command (MAC), or Headquarters, U.S. Air Force.

There is no single operation and support cost for an aircraft. One key determining factor is pace of operations--that is, the number of hours per day the aircraft is flown. A higher flying hour program costs more, not simply because of higher fuel consumption, but also because it requires more spare parts and more maintenance to support it. Figure 4 shows the relationship between flying hours and O&S costs for several aircraft.

Flying hours and resulting O&S costs chosen for this study are shown in Table 3. Two points deserve mention--the relatively low flying hours for

---

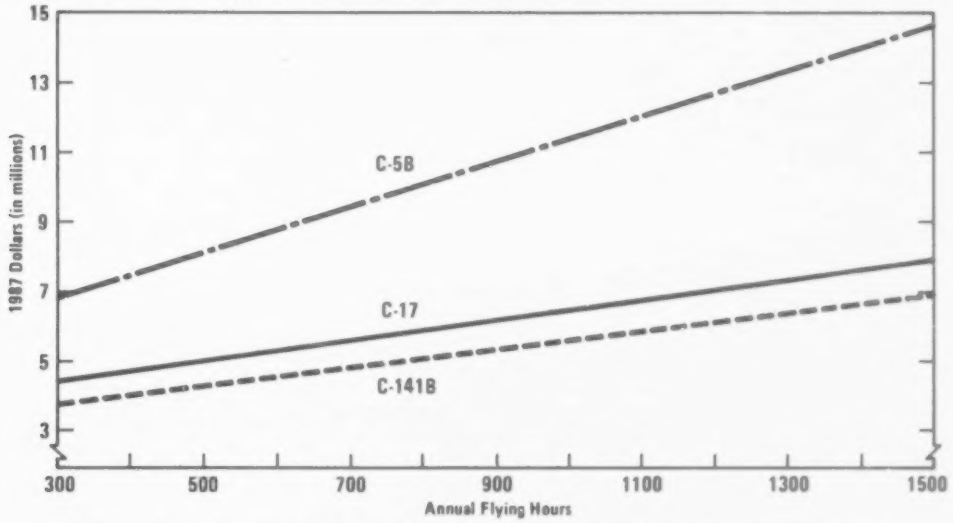
6. The data on O&S costs were supplied by Military Airlift Command (MAC). They were estimated using the Cost Oriented Resource Estimating (CORE) model, a standard model used by the Air Force for costing forces. In the case of aircraft currently in the airlift fleet--such as the C-5A, KC-10A, and C-141B--model parameters (including fuel consumption per flying hour, maintenance personnel, spare parts requirements, and squadron personnel) were set based on actual MAC experience and current policies for the use of these aircraft in peacetime. In the case of the C-17, these parameters were set based on engineering estimates and contractual warranties made by the manufacturer and on the Air Force's plans for using these aircraft.

the C-5B and KC-10A aircraft and the lower flying hours associated with aircraft assigned to the Air Reserve Forces. The Air Force chooses to limit peacetime use of the C-5 because of its high O&S cost per flying hour. New pilots leaving training programs are assigned to aircraft that are cheaper to fly; only experienced senior pilots, who need less flying hours to maintain proficiency, are assigned to the C-5.

KC-10A pilots (about 40 percent of whom are reservists) also fly fewer hours. The Air Force does not maintain a training squadron for the KC-10A, but relies instead on a simulator training program to familiarize a pilot with the aircraft and achieve a basic level of proficiency. Final training and qualification of pilots is conducted in operational squadrons.

By contrast, the Air Force intends to follow an ambitious peacetime flying hour program for the C-17. Each aircraft will fly on the average of 3.8 hours per day or nearly 1,400 hours per year. (Each C-5A currently averages 774 hours per year.) The Air Force reasons that this is necessary to provide adequate flying time for the five crews assigned to each operational aircraft. These crews would include inexperienced pilots who need additional flying time to gain experience and proficiency.

Figure 4.
Operation and Support Costs Per Aircraft



SOURCE: Congressional Budget Office estimates based on data supplied by the Department of the Air Force.

TABLE 3. OPERATION AND SUPPORT COSTS FOR VARIOUS AIRCRAFT

Aircraft Type	Number and Type of Crews Per Aircraft	Average Flying Hours (Per year)	Annual Operation & Support Cost (In millions of 1987 dollars)
C-5A	2 active/ 2 res. assoc.	774	10.9
C-5A	4 reserve	584	8.2
C-5B	2 active/ 2 res. assoc.	774	10.0
C-5B	2 active/ 2 res. assoc.	1,176 a/	12.7
C-17	5 active	1,397	8.6
C-17	3 active/ 2 res. assoc.	1,397	7.6
C-17	5 reserve	938	4.8
C-141B	2 active/ 2 res. assoc.	1,176	6.1
C-141B	2 active	810	4.4
C-141B	4 reserve	720	3.5
C-141B	2 reserve	358	2.2
KC-10A	2 active/ 1.5 reserve	819	4.8
C-130E/H	2 active	719	3.1
C-130E/H	2 reserve	468	1.7

SOURCE: Headquarters, Military Airlift Command (adjusted to 1987 dollars by the Congressional Budget Office).

a. Higher flying hours if each C-5B were required to support same number of pilots in force as the C-141.

These assumptions push up the cost of the C-17 relative to the C-5 and KC-10A. (For a more complete discussion of their implications, see Chapter III.)

Results of the Administration's Plan

CBO estimated the total discounted life-cycle cost of the airlift program for the 30-year period of 1987 through 2016. It chose a 30-year period to allow enough time for differences in operation and support costs to become significant factors in the total. Discounted at the rate of 2 percent per year, to provide a comparable figure to near-term spending, the Administration's plan yields a total cost of $118.1 billion, or an average cost of $3.9 billion per year over the 30-year period. 7/ This figure includes the savings associated with the retirement of 54 C-141Bs and 180 C-130s. It represents an increase of $30.1 billion, or 34 percent over the cost simply to operate the 1989 airlift fleet. The Administration's plan, however, achieves the goal of 66 MTM/D by the year 2000, an increase of 36 percent over the 1989 airlift level of 48.5 MTM/D. It also modernizes the intertheater airlift fleet and adds considerably to intratheater airlift capability.

---

7. The 2 percent rate represents CBO's current estimate of the real (inflation-adjusted) long-term interest rate. Appendix B examines the sensitivity of the long-run cost comparisons to the choice of discount rate.

CHAPTER III

ALTERNATIVE PROGRAMS TO IMPROVE STRATEGIC MOBILITY

There are alternative approaches to the Administration's plan that would either cost less or add to capability faster. All of them are built on the near-term program of airlift improvements--already funded--that would achieve an airlift capability of 48.5 MTM/D by 1989.

For example, the time required to achieve the goal of 66 MTM/D could be shortened by six years if the Congress canceled the C-17 program and continued to purchase the C-5B and KC-10A instead. This alternative would require less total funds for procurement, but would save relatively little overall once operating costs are considered.

Alternatively, the Congress could defer attaining the 66 MTM/D goal, at least within this century, and accept a lower level of airlift capability. A more limited acquisition of C-5s and KC-10s would achieve an intertheater airlift capability of 56 MTM/D by the year 1991. Not only would this alternative avoid acquisition costs, but the smaller airlift fleet would result in a lower annual cost for operation and support.

Finally, additions to maritime prepositioning would offer the least expensive way to increase strategic mobility. This third alternative would maintain the 48.5 MTM/D of airlift capability available by 1989, and direct additional spending to maritime prepositioning squadrons. It would also offer significant budgetary savings in both the near and long term. U.S. capability would, however, be more limited under this approach since it lacks the flexibility and rapid responsiveness that additional airlift would provide.

ALTERNATIVE I: ACHIEVE AIRLIFT GOAL EARLIER

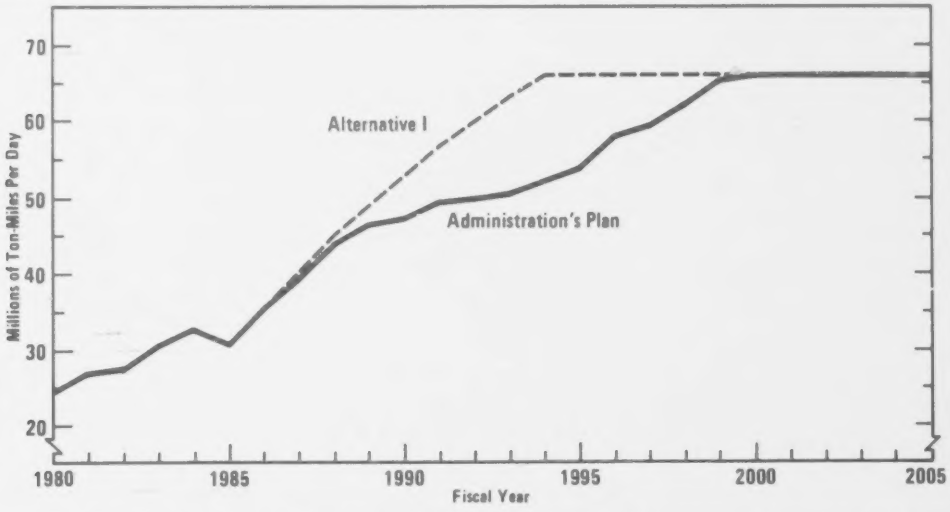
If the Congress wished to achieve the 66 MTM/D airlift goal earlier, it could continue to purchase the C-5B Galaxy aircraft and the KC-10A--both of which are in production--and expand plans for using commercial cargo aircraft such as the Boeing 747 or the unmodified DC-10. Under this alternative, the 66 MTM/D airlift goal would be achieved by 1994--six years earlier then under the Administration's plan (see Figure 5). This earlier gain could

be important if the airlift deficiency is as critical to U.S. warfighting capability as theater commanders claim. This alternative, however, would not achieve the Administration's goals for force modernization.

Specifically, 70 additional C-5Bs would ensure sufficient capacity to transport outsize cargo and, in fact, the C-5B is the only U.S. aircraft with this capability currently in production. But the C-5 is expensive to operate in peacetime. Therefore, the most cost-effective way to increase capability to transport bulk and oversize cargo is either through the CRAF program, which uses commercial cargo aircraft, or through the purchase of additional KC-10 aircraft. This alternative, then, would also buy 66 KC-10 aircraft and add 31 aircraft to the CRAF program. In addition, since the Air Force does not intend to employ the C-5B in the forward delivery role and since the KC-10 and CRAF aircraft require large improved runways not usually found in forward combat areas, this option would buy 180 new C-130H airlifters to replace the aging C-130 aircraft the Air Force plans to retire.

Alternative I would retire 54 C-141B aircraft just as in the Administration's plan. Under this approach, however, the remaining 180 C-141s would be kept at their current capability by retaining the four crews currently assigned to each aircraft rather than reducing the number of crews to

Figure 5.
Intertheater Airlift Comparison



SOURCES: Congressional Budget Office (for 1987-2005 projections); Department of the Air Force (for 1980-1986 data).

two per aircraft, as the Administration plans to do. 1/ The service life of each C-141 would also be extended from the current level of 45,000 flying hours to 60,000. This increase would most likely require rehabilitation of the engines and other maintenance to the airframe.

Increases in Capability

As noted above, Alternative I would meet the goal of 66 MTM/D by 1994. The 70 new C-5Bs would add 11 MTM/D of outsize capability, while the 66 KC-10s would provide 6 MTM/D to meet bulk and oversize requirements. The 31 commercial aircraft added to the CRAF program would effectively replace the 54 C-141s to be retired. Should the Air Force lower its utilization rate for the C-5, however, total capability under this approach would not meet the goal.

Near-Term Costs

Achieving the airlift goal earlier would cost more in the near term than the Administration's option. Alternative I procures 48 C-5 aircraft, 32 KC-10 aircraft, and 75 C-130 aircraft during the next five years at a cost of $9.9 billion (see Table 4). Extending the service life of the C-141 fleet to 60,000 hours and increasing the size of the CRAF fleet will add an additional $1 billion for a total cost for this option of $10.9 billion.

CBO based its estimates of aircraft prices on firm offers by contractors where possible. The Lockheed Corporation recently offered to sell the Air Force 24 additional C-5B aircraft at an average flyaway cost of $108 million (at 1987 budget prices). The KC-10 aircraft averages about $63 million apiece. The KC-10 is currently being acquired through a multiyear contract that incorporates an economic price adjustment (EPA) clause to price each year's deliveries. CBO based its estimates of the cost of additional KC-10 purchases on a McDonnell Douglas proposal to extend the KC-10 procurement with a similar multiyear contract.

Costs for the enhanced CRAF program were estimated at $0.6 billion over 1987 through 1991 and $1.0 billion for all 31 aircraft. Part of these funds would pay for modifications to wide-body passenger aircraft that

---

1. Each active force C-141 squadron has 36 crews for its 18 primary aircraft. Associated with the active squadron and using its equipment is an Air Force Reserve squadron (36 crews), making a total of 72 crews, or four per aircraft. The Air Force plan would transfer the C-141 equipment to the reserve squadron as new C-17 aircraft became available to equip the active squadron.

TABLE 4. ACHIEVE AIRLIFT GOAL EARLIER: QUANTITIES AND ACQUISITION COSTS
(In billions of 1987 budget year dollars)

Aircraft	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Program
C-5B								
Quantity	a/	12	12	12	12	48	22	70
Cost	0.3	1.5	1.5	1.4	1.4	6.1	2.2	8.4
KC-10A								
Quantity	a/	8	8	8	8	32	34	66
Cost	0.4	0.4	0.5	0.5	0.5	2.3	1.7	4.0
C-141 (Modifications)								
Cost	0	b/	0.1	0.1	0.1	0.4	0.3	0.7
C-130H								
Quantity	15	15	15	15	15	75	105	180
Cost	0.3	0.3	0.3	0.3	0.3	1.5	2.0	3.5
Civil Reserve Air Fleet (CRAF)								
Quantity	5	3	4	3	3	18	13	31
Cost	0.2	0.1	0.1	0.1	0.1	0.6	0.4	1.0
Total Cost	1.1	2.4	2.5	2.5	2.4	10.9	6.7	17.6

SOURCE: Congressional Budget Office.

a. Quantities and costs to complete the near-term airlift program are excluded.
b. Less than $50 million.

would allow them to be converted quickly to cargo freighters in an emergency. Because these modifications add weight and increase fuel consumption, the total cost also includes a payment to the aircraft owners to compensate for higher operating costs.

Total Program Costs

Procurement for this program would continue beyond the next five years. As noted above, this option would eventually purchase 70 C-5Bs, 66 KC-10s, and 180 C-130Hs (the latter replacing the 180 C-130 aircraft to be retired). Procurement programs for these aircraft at current prices results in a total acquisition cost of $17.6 billion over the 1988-1994 period (see Table 4). This amount is 40 percent less than the $29.3 billion CBO estimates would be spent on the Administration's plan.

Total Life-Cycle Costs

Since life-cycle costs include both acquisition and operating and support costs, they provide a better picture of the true cost of this alternative. CBO estimates that Alternative I would result in a total discounted life-cycle airlift cost of $114.4 billion over the 1987-2016 period. 2/ This figure is $3.7 billion, or 3 percent, less than the $118.1 billion cost of the Administration's plan.

These results differ from Air Force estimates published in 1983, which found the C-5 approach to be more expensive. The main reason for the difference is that the Air Force examined an "all C-5" alternative. The alternative CBO examined would buy some C-5s needed to carry outsize cargo but also cheaper KC-10As and CRAF aircraft that could carry other types of cargo. Since 1983, assumed costs to buy and operate the various aircraft have changed--the C-5B became cheaper to buy and the projected cost to operate the C-17 increased. Declining fuel prices have also lessened the cost advantage of the C-17 over the C-5.

The CBO estimate for this plan assumes current operating hours for the new C-5Bs and Air Force estimates for manning. But both of these assumptions are subject to variations that could alter results.

Personnel Costs. The Air Force estimated that choosing the C-17 (the Administration's plan) would result in a net reduction of 3,366 personnel. In

---

2. This estimate uses a 2 percent discount rate. Appendix B compares the long-term costs at other discount rates.

contrast, Alternative I requires an increase of 9,000 personnel, resulting in a total difference of about 12,400 positions between the two plans. Much of this difference results from the Air Force's plan to reduce the number of C-130 tactical airlift aircraft to 342, which eliminates 7,020 positions. Alternative I would retain these positions.

The Air Force may change its plan to retire 180 C-130 aircraft without replacing them. (DoD is currently reevaluating the intratheater airlift requirement.) Thus, although the Air Force claims that the forward-delivery capability of the C-17 will more than offset the loss of the C-130s, additional intratheater capability may still be necessary to meet higher DoD requirements. If so, retaining the C-130s would eliminate some or all of the projected personnel savings that would accrue with the Air Force plan, and would reduce the difference between it and the CBO alternative plan. On the other hand, if DoD decides on a requirement for greater intratheater airlift than exists today, more C-130s than are assumed in this alternative would be required.

C-5 Operating Costs. Choosing the C-5 instead of the C-17 may lead to higher operation and support costs. Currently, the Air Force restricts the flying hours of the C-5--because of its higher per hour cost--and generates most of the operational flying needed to give its pilots experience in C-141s and C-130s. Were the C-17 program to be canceled and C-5s bought instead, it would be necessary--the Air Force contends--to increase average peacetime flying hours for the C-5 from 774 hours per year to 1,176 hours--the same rate as the C-141 is operated currently--in order to maintain an adequate flying hour program. This change would increase the annual operation and support cost per aircraft by $2.7 million, or 27 percent, and would increase the discounted total cost of Alternative I to $120.6 billion, $2.5 billion more than the Administration's plan. The Air Force might, however, meet its personnel needs in other ways, such as continuing to operate the C-141 fleet with four crews per aircraft, as Alternative I assumes.

Thus, Alternative I, which achieves wartime capability equal to the Administration's alternative six years earlier, would save about 3 percent relative to the Administration's plan. Under different assumptions about C-5 operations, however, Alternative I might cost more than the Administration's plan.

ALTERNATIVE II: ACCEPT A LOWER AIRLIFT GOAL

Alternative I would clearly not greatly reduce airlift costs, which may be necessary in a period of fiscal restraint. CBO's second alternative, there-

fore, lowers costs more substantially by building up long-range airlift capability only to 56 MTM/D, rather than to the Administration's goal of 66 MTM/D. Under this alternative, the Air Force would buy C-5 and KC-10 aircraft rather than the C-17. Since a smaller number of aircraft are needed in order to meet the 56 MTM/D goal, it is more effective to buy existing types of aircraft than to complete development and build a new aircraft such as the C-17.

Are 56 MTM/D Enough?

Estimates of military requirements are inherently uncertain, depending as they do on the uncertain nature of future conflicts (for example, the location of the threat, the speed of response, the type of forces required, and so forth). Nonetheless, one can examine the 56 MTM/D figure in terms of current estimates and history.

Major Scenarios. Estimated airlift requirements in the early days of a major conventional conflict involving the Soviet Union might greatly exceed even the Administration's goal of 66 MTM/D. The *Congressionally Mandated Mobility Study* examined airlift requirements for several scenarios. An all-out war in Europe might well require 479,000 tons of cargo in a 15-day period, or a capability of about 112 MTM/D. A demanding war in Southwest Asia could require the delivery of 206,000 tons of equipment and material within the first 15 days, a rate of about 96 MTM/D.

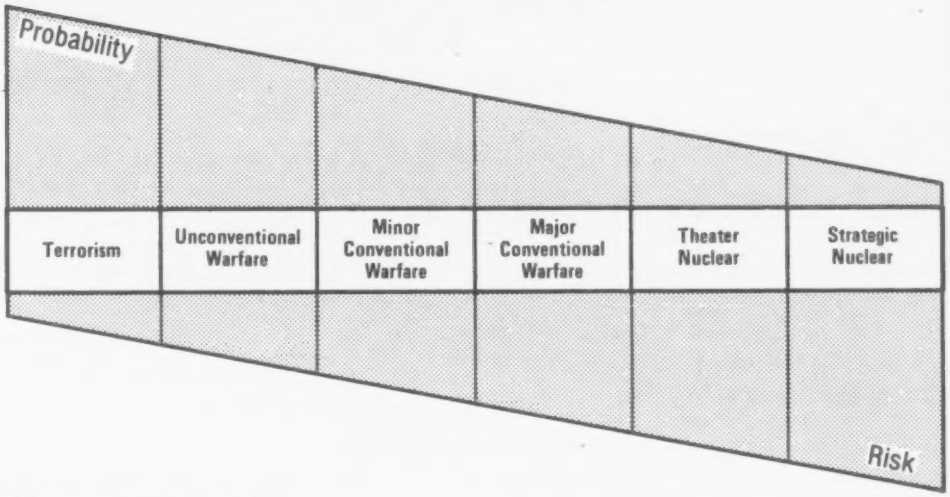
Perhaps because of these large potential needs, theater commanders would not support lowering the goal to 56 MTM/D. General Bernard Rogers, Commander in Chief of the U.S. European Command, has said that, in the face of a large conventional attack, early reinforcement would be crucial for avoiding the necessity to escalate to the use of nuclear weapons. 3/ While a smaller airlift force would eventually deliver the needed tonnage, it would not achieve the delivery schedule that theater commanders believe necessary to counter the threat.

Lower-Intensity Conflicts. A smaller airlift force would meet requirements in more limited or less intense wars, indeed the most likely future conflicts. In general, the likelihood of any given level of conflict is inversely related to its intensity (see Figure 6). As General Nutting (formerly Commander in

---

3. General Bernard Rogers, statement before the Committee on Armed Services, United States Senate, March 12, 1986, p. 7.

Figure 6.
"Spectrum of Conflict" Approach to Force Planning



SOURCE: Department of the Army.

Chief, U.S. Readiness Command) points out, "Since World War II, we have been involved in well over 200 contingency operations--operations considerably short of war, many of which required a military response of some dimension.... Throughout the world today there are 40 conflicts in progress. Thirty-five of these fall into the Low-Intensity Category." 4/

Recent history and projections suggest that existing airlift assets are more than adequate to deal with these low-intensity conflicts, as was demonstrated in the Grenada operation and United States support to Israel during the 1973 war. Moreover, should deployment of forces to Central America become necessary, the capability of existing airlift would be sufficient since distances are so relatively short. A separate problem is the limited number of airfields in the region. Airfield saturation, not airlift capability, would constrain cargo movement in Central America. This problem argues for using the C-17 for this type of conflict since the C-5 would operate less efficiently on small airfields.

Capability in Previous Conflicts. This nation has never maintained an airlift force with a capability anywhere near as great as 66 MTM/D. By the end of

4. Wallace H. Nutting, "Strategic Mobility: A Puzzle Which Must Be Solved," *Government Executive*, vol. 17 (January 1985), p. 26.

World War II, for example, the Air Transport Command (predecessor to today's Military Airlift Command) had over 3,700 aircraft and was moving just under 100,000 tons of cargo and mail per month on long- and short-haul missions. 5/ But because these missions averaged less than 1,000 miles at speeds of less than 200 nautical miles per hour, the capability of this force (by the modern measure) probably would not have exceeded 5 MTM/D. 6/ Needless to say, the aircraft of the time had little capability to carry equipment, and loading and unloading cargo was slowed by the lack of a standard pallet system.

In 1969, near the peak of the Vietnam War effort, the Military Airlift Command (MAC) moved over six billion ton-miles of cargo, or about 16 MTM/D, counting both inbound and outbound traffic. 7/ An example of deployment more comparable to a surge effort, however, is that of the 101st Airborne Division in 1967, when approximately 10,000 troops and 5,000 tons of cargo were transferred from Fort Campbell, Kentucky to Bien Hoa, Vietnam. This effort required 413 airlift sorties over a 43-day period, a rate (for cargo only) of 1.1 MTM/D. 8/ A more intensive rate of activity was recorded in 1968, when 6,000 troops and 3,500 tons of cargo were redeployed to Korea within a 10-day period as a result of the Pueblo incident, a rate of nearly 3 MTM/D. 9/

While the Vietnam War represented a substantial conflict that appeared to involve low rates of airlift, surge requirements cannot be determined from the Vietnam experience, since U.S. entry into the theater was incremental. It is clear, however, that once the surge period of deployment is over, sustaining requirements for airlift are unlikely to exceed 35 MTM/D. 10/ This figure is less than the amount of sustained airlift capa-

---

5. W. F. Craven and J. L. Cate, *The Army Air Forces in World War II: Volume VII, Services Around the World* (Washington, D.C.: Office of Air Force History, 1983), p. 19.

6. James P. Crumley, Jr., *Intertheater Airlift: What's There To Do Once the SEALOC Closes?* (Washington, D.C.: Industrial College of the Armed Forces, 1986), p. 30.

7. U.S. Department of the Air Force, *History of the Military Airlift Command, 1 July 1969-30 June 1970*, vol. I (Washington, D.C.: January 1971), p. 18.

8. Kenneth Patchin, "Strategic Airlift," Chapter X of *The United States Air Force in Southeast Asia*, Carl Berger, ed. (Washington, D.C.: Office of Air Force History, 1977), p. 197.

9. Ibid.

10. Crumley, *Intertheater Airlift*, p. 83.

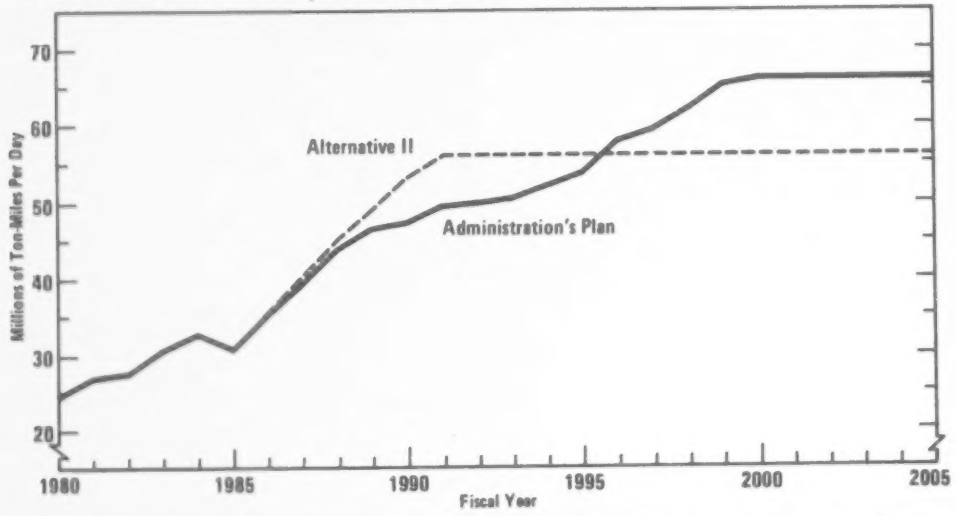
bility that will be available when all the C-5Bs and KC-10s already ordered are delivered.

Capability and Cost

If the Congress judged that 56 MTM/D were an adequate goal, it could proceed with this alternative, which would mean canceling the C-17 program and buying C-5B and KC-10A aircraft instead, though in smaller quantities than those considered for Alternative I. Specifically, Alternative II would require purchasing an additional 24 (21 PAA) C-5Bs and 40 (36 PAA) KC-10As, as well as extending the useful service life of 180 of the C-141s. In addition, 31 more wide-body aircraft would be added to the CRAF program and 180 C-130s would be replaced, just as in Alternative I. (Other mixes of aircraft are possible as well; the plan CBO devised was based on actual offers by the manufacturers where possible.)

Alternative II would achieve 56 MTM/D of capability by 1991 (see Figure 7). Added capability would come equally from the two types of aircraft (as 21 C-5Bs and 36 KC-10s each would provide 3.6 MTM/D of intertheater capability).

Figure 7.
Intertheater Airlift Comparison: Lower Airlift Goal



SOURCES: Congressional Budget Office (for 1987-2005 projections); Department of the Air Force (for 1980-1986 data).

One clear finding of CBO's analysis is that, if the Congress elects a lower goal for airlift than the 66 MTM/D, it should reexamine the need for the C-17. For example, if the goal were 56 MTM/D, only 132 C-17s would be needed. At this lower production figure, their average total program cost would be about $175 million, 23 percent greater than under the Administration's alternative. In other words, the C-17 would be significantly less cost effective in the intertheater role if the airlift goal were lower.

Total program cost for Alternative II is $10.7 billion, of which $7.7 billion would be spent over the next five years (see Table 5). Because this option would result in a smaller airlift fleet, costs to operate and support the entire fleet would be less than under the Administration's plan. CBO estimates the total discounted life-cycle cost of this option to be $98.5 billion. This figure is $19.6 billion less than the life-cycle cost of the Administration's plan, or a reduction of about 17 percent.

ALTERNATIVE III: EMPHASIZE MARITIME PREPOSITIONING INSTEAD OF AIRLIFT

While Alternative II cuts long-term costs, it only modestly reduces costs in the next few years. One way to do this, while also achieving large reductions in long-term costs, is through maritime prepositioning.

Prepositioning means placing unit equipment and initial supplies within the combat theater, and represents another way to meet mobility requirements. It eliminates the need to buy strategic airlift or sealift assets to move the items. In the event of a crisis, unit personnel and any remaining nonprepositioned equipment would be flown to the storage area (if prepositioning is on land) or to the point where ships would unload (if prepositioning is sea-based). Once unit personnel arrive, two to three days would be required to get the equipment ready to move, depending on the size of the unit. Per-sonnel would then proceed to the combat area onboard the equipment or by using tactical airlift.

Current Prepositioning

The CMMS recommended adding 130,000 tons of prepositioned material in Southwest Asia and expanding the prepositioning program already under way in Europe. In 1984, the Congress released funds authorizing the Army to preposition two additional division sets of equipment in Europe (raising the total to six). In addition, equipment for a Marine brigade was prepositioned in Norway and work is under way to increase in-theater support for tactical

TABLE 5. ACCEPT A LOWER AIRLIFT GOAL: QUANTITIES AND ACQUISITION COSTS
(In billions of 1987 budget year dollars)

Aircraft	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Program
C-5B								
Quantity	a/	12	12	0	0	24	0	24
Cost	0.3	1.5	1.2	0	0	3.0	0	3.0
KC-10A								
Quantity	a/	8	8	8	8	32	8	40
Cost	0.4	0.4	0.5	0.5	0.4	2.3	0.2	2.5
C-141 (Modifications)								
Cost	0	b/	0.1	0.1	0.1	0.4	0.3	0.7
C-130H								
Quantity	15	15	15	15	15	75	105	180
Cost	0.3	0.3	0.3	0.3	0.3	1.5	2.0	3.5
Civil Reserve Air Fleet (CRAF)								
Quantity	5	3	4	3	3	18	13	31
Cost	0.2	0.1	0.1	0.1	0.1	0.6	0.4	1.0
Total Cost	1.1	2.4	2.3	1.0	0.9	7.7	3.0	10.7

SOURCE: Congressional Budget Office.

a. Quantities and costs to complete the near-term airlift program are excluded.
b. Less than $50 million.

aircraft that would be deployed to Europe in wartime. Because of the time required to negotiate funds to construct facilities for storing this equipment, and because other needs exist for much of the equipment being prepositioned in Europe, accomplishing this prepositioning has lagged.

The CMMS recommendations for prepositioning outside of Europe have also been pursued, but with only limited land-based prepositioning. Outside of Europe and South Korea, there are few sites where extensive land-based prepositioning is feasible or prudent. The combination of local sensitivities and instability of regional governments (witness Iran) argues against the United States placing valuable military assets at risk. A limited amount of material has been prepositioned in the Persian Gulf region, but secure locales for additional sites are difficult to obtain. Maritime prepositioning--storing equipment and supplies on board ships--is an alternative in this case.

In response to the increased threat to the oil-producing nations of the Persian Gulf, the Carter Administration established the Near-Term Prepositioning Force (NTPF) at Diego Garcia in the Indian Ocean to support Army, Navy, and Air Force units of the Rapid Deployment Force (now the U.S. Central Command). The original prepositioning force of 17 ships (13 in the Indian Ocean and four at other locations) has now been augmented with two Maritime Prepositioning Ship (MPS) squadrons. Each squadron consists of four or five ships and carries all the ground equipment for a Marine brigade, together with supplies and ammunition to support that force for 30 days. One more MPS Squadron--supporting a third Marine brigade--will be deployed this year.

Additional Maritime Prepositioning

Further maritime prepositioning could be accomplished anywhere that a secure location can be established for prepositioning ships. This alternative assumes that enough equipment for an Army division (about 16,000 troops) would be prepositioned on 12 MPS ships. Military leaders would establish the location of the prepositioning in light of likely military contingencies, and could alter it as circumstances change.

Under Alternative III, no additional aircraft for intertheater strategic mobility would be purchased, but the 12 ships should more than make up for this loss in added ability to move heavy equipment. Indeed, it would take the entire fleet of 210 C-17s that the Administration plans to buy some 18 days to move the same amount of equipment to Southwest Asia as would be prepositioned on the 12 ships acquired under this approach. In contrast, were the ships to be deployed on warning from Diego Garcia (an island in the

Indian Ocean where the United States currently has material prepositioned), it would take two days for them to reach Persian Gulf ports and another three to five days to unload. This gain of 11 to 13 days could significantly alter the outcome of a military conflict in that region.

While this option would not purchase more strategic airlift, it would buy more tactical airlift. Prepositioning can get equipment to the theater but not to the exact location where it is needed. Therefore, this alternative assumes the purchase of 180 new C-130s to replace the older ones that are to be retired. While this purchase would maintain current intratheater airlift capability, it would not provide the ability to project heavy forces by air deep into the interior, as the C-17 would. Alternative III also extends the life of C-141s and continues to use them at current rates to help meet strategic airlift requirements.

Costs

Near-term investment costs for Alternative III are much lower than the other alternatives, in part because of special financing arrangements. The maritime prepositioning ships currently being acquired were obtained through a leasing arrangement with private owners. Lease costs are paid annually from Navy operation and maintenance appropriations. This alternative follows that practice. Since the Navy's current annual cost of leasing averages $25.5 million dollars per ship, $306 million a year in lease costs are estimated for the 12 ships necessary to hold a division set of equipment.

This amount does not include additional government costs resulting from the tax implications of leasing. Recent changes in tax laws will affect leasing offers for new ships and make purchase of them more attractive. A review by the Congressional Research Service found the cost to the government of leasing would be 3 percent to 12 percent more than the purchase price. 11/ The prepositioning approach would still be considerably cheaper, however, even if the ships were purchased outright. In 1982, the cost of newly-built or converted prepositioning ships was less than $200 million. In today's depressed shipbuilding market, it might be even lower.

For comparability with the other alternatives, lease costs are included in near-term investment costs, even though they would not be paid from procurement funds. Investment costs for this option over fiscal years 1987

11. Jane Gravelle, "Comment on Study of Lease vs. Purchase of Naval Ships" (Washington, D.C.: Congressional Research Service, February 18, 1983).

through 1991 total only $4.0 billion (see Table 6). Of that amount, $2.0 billion is airlift-related (for the purchase of C-130Hs and modification of C-141s). Another $1.0 billion pays for 40 percent of the military equipment to be prepositioned on the ships. Initially, equipment could be drawn from existing stocks. But equipment would eventually have to be replaced so that enough would be available for peacetime training and other needs. CBO assumes replacement would start in 1988 and be accomplished gradually. About $0.9 billion in lease costs would be paid from the Navy operation and maintenance account in these five years. Finally, $0.1 billion in CRAF costs are included to meet the Air Force's goal of 11.3 MTM/D in CRAF.

Total investment costs for Alternative III equal $15.4 billion compared with $29.3 under the Administration's plan. These costs include $3.5 billion to buy 180 new tactical aircraft plus a total of $2.5 billion to buy all the extra equipment needed for the division. Total program costs also include total lease costs of $8.6 billion over the entire 30-year period of 1987 through 2016.

Discounted life-cycle costs under this approach total $99.7 billion compared with $118.1 billion under the Administration's plan. (These costs include costs to operate the 1989 airlift fleet as well as the costs of the prepositioning increment.) This reduction of about 16 percent reflects not only the lower acquisition costs noted above but also the reduced costs of operating an airlift fleet with only 48.5 MTM/D of capability.

This comparison of life-cycle costs may, in fact, understate the cost advantage of maritime prepositioning over airlift. The entire fleet of C-17s that the Administration would buy could move one division's equipment in 18 days. In that period, equipment prepositioned anywhere near a conflict zone could probably reach the area, be unloaded, and moved to the area of conflict. Yet, the added cost of the Administration's plan, in terms of discounted life-cycle costs, would total $30.1 billion--about 2.6 times the added life-cycle costs of the ships, equipment, and tactical airlift purchased under this alternative.

Disadvantages

Despite its dramatic cost advantage, maritime prepositioning does have some important disadvantages compared with airlift. Alternative III's maritime prepositioning would itself add to airlift requirements, about 5 MTM/D for a heavy mechanized division prepositioned in the Indian Ocean. Because of the high value of some items and the problems of maintaining some equipment aboard ships, not all unit equipment can be prepositioned on

TABLE 6. EMPHASIZE MARITIME PREPOSITIONING: QUANTITIES AND ACQUISITION COSTS
(In billions of 1987 budget year dollars)

Aircraft	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Program
C-141 Modifications (267 Aircraft)								
Cost	0	a/	0.1	0.2	0.2	0.5	0.3	0.8
C-130H								
Quantity	15	15	15	15	15	75	105	180
Cost	0.3	0.3	0.3	0.3	0.3	1.5	2.0	3.5
Maritime Prespositioning Ships								
Quantity	0	0	12	0	0	12	0	12
Lease Cost	0	0	0.3	0.3	0.3	0.9	7.7	8.6
Equipment Purchase								
Cost	0	0.3	0.3	0.3	0.3	1.0	1.5	2.5
Total Cost	0.3	0.6	0.9	1.0	1.0	3.9	11.5	15.4

SOURCE: Congressional Budget Office.

a. Less than $50 million.

ships. Helicopters, for example, are not prepositioned and would still need to be transported to the combat zone. The 5 MTM/D requirement, however, could be met without buying additional aircraft--for example, by delaying the deployment of the Army's new light division. The increased firepower and ground mobility that the prepositioned heavy division provides should more than compensate for the delayed arrival of a light division.

More importantly, maritime prepositioned equipment must be unloaded, which requires either access to port facilities or specialized equipment and auxiliary vessels, such as crane ships (TACS). The current DoD program to build such vessels is sized to the current sealift and maritime prepositioning program; thus, additional ships and equipment might be required under this alternative. Also, once alerted, the ships must sail to their point of debarkation, which might take four to five days if prepositioning were, for example, in Diego Garcia. Like other sealifted material, equipment must then travel under its own power or be transported from the port to the combat area. As a result, the initial increments of prepositioned equipment are likely to arrive later than the earliest equipment shipped by air. This time lag could be important in some military situations.

SUMMARY OF COST COMPARISONS

Table 7 summarizes the results of the cost comparisons in this study. In terms of near-term investment costs for the next five fiscal years (1987-1991), little choice exists among the three airlift options. All three of them would require budget authority of $7 billion to $11 billion in the five-year defense program. No opportunity for near-term savings is available because, if the Congress were to cancel the C-17 program, it would have to fund continued production of C-5Bs and KC-10As before the production lines for those aircraft are torn down.

In the longer term, however, by buying the alternative aircraft instead of the C-17, the Congress could achieve the 66 MTM/D airlift goal six years earlier and still save $3.7 billion dollars, or about 3 percent of the 30-year airlift bill. The Congress would have to weigh this earlier gain in capability against the qualitative improvements expected with the C-17.

As an alternative, the Congress could undertake a more modest program of airlift improvements, raising capability to 56 MTM/D rather than the 66 MTM/D level the Administration seeks. This approach would save $19.6 billion, or about 17 percent, over the next 30 years. This level of capability, however, would not meet airlift requirements for an intense conflict with the Soviet Union.

As a third alternative, the only one that offers the prospect of significant near-term budgetary savings, the Congress could forgo any further improvements in airlift once the 48.5 MTM/D level is reached, and instead invest in additional prepositioning of equipment and supplies. Savings from this option amount to $6.1 billion in investment costs over the next five years. Long-term discounted costs for this option, estimated at nearly $100 billion, are comparable to those for Alternative II, which limited airlift expansion. Because this option could provide a fully-supplied heavy Army division to the theater commanders within two weeks of the outbreak of hostilities, the war-fighting enhancement this option offers is more comparable to the Administration's plan, which provides the full 66 MTM/D of intertheater airlift.

Costs, of course, are not the only consideration. As the discussion above noted, the approaches outlined in this chapter vary in the time required to meet airlift goals or, in the case of the prepositioning option, in the rapidity with which cargo could be moved once a conflict began.

TABLE 7. SUMMARY OF COSTS FOR THE OPTIONS
(In billions of 1987 budget year dollars)

	Near-Term Investment Cost	Total Cost for 30 Years a/
Administration's Plan	10.1	118.1
Achieve Airlift Goal Earlier	10.9	114.4
Accept a Lower Airlift Goal	7.7	98.5
Emphasize Maritime Prepositioning	4.0	99.7

SOURCE: Congressional Budget Office.

a. Discounted at a 2 percent real rate.

APPENDIXES

APPENDIX A

DESCRIPTIONS OF TRANSPORT AIRCRAFT

The transport aircraft currently available to support airlift operations range from the giant C-5 Galaxy to the veteran C-130 Hercules. In terms of capabilities, the proposed new C-17 falls in between. Externally, it is about the same size as the C-141, but will carry twice the cargo as the latter over a longer range. Moreover, like the C-130, it will be able to operate routinely on smaller airfields, but with a much greater payload. The technical specifications of these military airlift aircraft, as well as commercial cargo aircraft, are described below.

C-17 Aircraft

The C-17 will be a high-wing, T-tail, long-range jet transport. It will be powered by four Pratt & Whitney PW 2037 turbofan engines, which are now in commercial service. The C-17 will carry its maximum payload of 172,000 pounds of cargo for at least 2,400 nautical miles. Examples of its payload include 18 standard military pallets, or one M1 tank and one Bradley fighting vehicle, or eight medium trucks. (Characteristics of the C-17 and other transport aircraft are presented in Table A-1.)

The C-17 is currently being developed by the McDonnell Douglas Corporation (MDC). A preliminary development contract was awarded to MDC in July 1982, as a result of a design competition in which Lockheed Corporation and Boeing Aircraft Company also participated. Full-scale development was authorized in 1985, and the first flight is now scheduled for 1990, with initial operating capability for a 12-aircraft squadron in 1992.

The C-17 has been designed to achieve better reliability and requires less maintenance than existing military transport aircraft. It can also be operated by a minimal crew (pilot, copilot, and loadmaster). In addition, its design incorporates capabilities--such as the low altitude parachute extraction system and combat offload techniques--more typical of smaller, tactical aircraft such as the C-130. In short, it was designed to combine the heavy lift capability of a long-range transport with the austere airfield capability of a tactical airlifter.

TABLE A-1. CHARACTERISTICS OF U.S. MILITARY TRANSPORT AIRCRAFT

Specification	C-130H	C-141B	C-5B a/	KC-10A	C-17
Dimensions (feet)					
Wingspan	133	160	222	165	165
Length	100	168	248	182	175
Height	38	39	65	58	53
Cargo Compartment (feet)					
Width	10.0	10.2	19.0	18.2	18.0
Length	39.2	93.3	121.0	125.7	85.2
Height (at highest point)	9.0	9.1	13.5	10.9	12.3
Floor area (square feet)	370	937	2,747	n.a.	1,534
Weight (thousands of pounds)					
Empty weight	74	149	363	241	237
Maximum gross weight	155	343	837 b/	590	570
Maximum payload	35	95	261	169	172
Average payload c/	25	55	138 d/	83	97
Performance					
2,500 nm. (nautical miles)					
Block speed (knots) e/	260 f/	410	423	445	440
Range (nm.) g/	2,038	2,550	2,738	3,800	2,400
Objective utilization rate	3.0	12.5	12.5	10.0	15.2
Minimum takeoff h/	2,300	8,420	7,450	11,000 i/	4,360
Minimum landing j/	2,360	3,840	4,610	4,500	2,420
Minimum runway width	60	98	147	148	90

(Continued)

Specification	C-130H	C-141B	C-5B a/	KC-10A	C-17
Cargo Capabilities					
463L pallets	6	13	36	27	18
Oversize cargo	Yes	Yes	Yes	Some k/	Yes
Outsize cargo	No	No	Yes	No	Yes
Combat offload	Yes	Yes	No	No	Yes
Low altitude parachute extractions	Yes	No	No	No	Yes
Airdrop cargo	Yes	Yes	Yes	No	Yes
Other					
Crew size	4	4	6	4	3
Fuel consumption (gallons/hour)	785	2,025	3,455	2,985	2,625
Total manpower per MTM/D	n.a.	1,544	877	517 l/	676
Inflight refueling	No	Yes	Yes	Yes	Yes

SOURCES: Except as noted below, source for all data on the C-130H, C-141B, and C-5B is Department of the Air Force, "Airlift Planning Factors," AFR 76-2 (February 17, 1982). Source for the KC-10A is "Specifications," *Aviation Week and Space Technology* (March 10, 1986), pp. 148-150. Source for the C-17 is U.S. General Accounting Office, "Performance Capabilities of the C-5 and C-17 Cargo Aircraft," NSIAD 84-119 (July 9, 1986), Appendix II. Average payload and utilization rates are reported in Department of the Air Force, *Airlift Master Plan* (September 1983), Table A-2.

NOTE: n.a. = not applicable.

a. C-5As that have undergone wing modification are essentially identical.
b. Limit for 2.25 G maneuver load factor. Higher gross weight takeoff capability demonstrated in tests; manual sets 764,500 pound limit.
c. Average payloads used in *Airlift Master Plan* capability calculations.
d. Based on higher gross weight limit established in tests; Lockheed estimates an average payload of 155,000 pounds.
e. Average speed over a 2,500 nautical mile range, including time spent in takeoff, climb to cruising altitude, approach, and landing.
f. 1,500 nautical mile block speed for C-130H.
g. Maximum range with maximum payload and standard MAC fuel reserves.
h. With maximum payload for 2.25 maneuver load factor and maximum fuel.
i. Critical field length (sea level, 90° F).
j. With maximum payload and fuel for 500 nm. return with zero payload.
k. Oversize cargo must be mounted on a pallet or two pallets joined together.
l. This figure excludes contractor support.

At its present stage of development, the C-17 aircraft appears capable of meeting (and in some cases, exceeding) all of the requirements set by the Air Force. In addition, many of the specifications for performance, such as the reliability and maintainability standards, the structural integrity of the airframe and components, and the takeoff/landing performance will be warranted by the manufacturer, so that any deficiencies must be corrected at no increase in contract price. But such capabilities do not come cheaply. The acquisition cost of the C-17 is currently estimated to average $142 million (in constant 1987 dollars of budget authority).

C-5A/B Galaxy

The largest aircraft operated by the Military Airlift Command is the Lockheed C-5 Galaxy. The original A model of the C-5 was produced from 1968 to 1973. Seventy-seven of these original aircraft remain in service with MAC. The C-5 can carry up to 174,500 pounds of cargo for a range of 3,000 nautical miles. One C-5 can transport 6 AH-64 Apache helicopters or 2 M1 tanks or 6 Bradley fighting vehicles, or 36 standard military pallets.

Wing Loading Restrictions. The C-5's impressive capabilities have never been fully realized, however. Not long after the aircraft entered service, wing cracks appeared on some aircraft, leading the Air Force to limit the peacetime operation and payload of the aircraft in the interest of extending its service life. The original C-5As are currently undergoing modifications to strengthen their wings, and these modifications have also been incorporated into the new C-5Bs now being delivered. The service life of the aircraft is now estimated at 30,000 hours.

Direct Delivery. The C-5 could be used for direct delivery to some forward airfields. When it was designed, the C-5 was to operate into limited forward airfields just as the C-17 is now planned to do: "the aircraft shall be designed to permit delivery of these forces in or near the objective area utilizing relatively short, low strength airfields." 1/ The Air Force, however, has not operated these aircraft on such airfields in peacetime and does not plan to do so routinely in wartime. A main reason is the inability of the aircraft to operate routinely on restricted taxiways and ramp spaces. Another reason is the fear that, should a maintenance problem ground the aircraft, the sheer size of the C-5 would disrupt airfield operations.

Payload Capacity. The manufacturer of the C-5 also asserts that the aircraft is capable of carrying a larger payload than the Air Force currently

1. Air Force Systems Command, Request for Proposal 33-647-5027 (October 9, 1964).

permits. This extra capability may affect the number of aircraft needed to achieve the 66 MTM/D intertheater airlift goal and the cost of options featuring procurement of additional C-5Bs. Recently, the Air Force tested the performance of the C-5B at gross weights exceeding the 772,000 pound limit specified in the C-5's operations manual. The tests indicated that the C-5 could take off with a gross weight of 837,000 pounds and could be refueled in flight to a higher limit, although the aircraft became considerably more difficult to control.

These results, obtained under special test conditions, may not be significant for ordinary field operations. The usefulness of this extra weight depends, of course, on what kind of cargo is being carried and where it can be delivered. Floor space, not weight, is often the limiting factor in loading an aircraft. Aircraft loading exercises performed by the Lockheed Corporation, based on actual mixes of cargo used in mobility analyses such as the CMMS, suggest that the average realized payload of the C-5, given this higher limit, would grow from 68.9 tons to 77.5 tons--a productivity increase of about 13 percent.

Cost of the C-5s. The 50 C-5s currently being procured cost an average of $168 million (in fiscal year 1987 dollars). The Lockheed Corporation has recently offered to sell the Air Force 24 additional aircraft at an average price of $90 million in constant 1984 dollars. Based on this offer, CBO estimates that unit program costs for the C-5, including support costs, would be about $125 million in 1987 dollars.

KC-10A Cargo/Tanker Aircraft

The KC-10A is a military version of the commercial DC-10 aircraft manufactured by the McDonnell Douglas Corporation. It is a three-engine, wide-bodied transport that can be operated either as a tanker or as a cargo aircraft. Currently, all KC-10s are operated by the Strategic Air Command, primarily as tankers.

The KC-10A is incapable of carrying outsize equipment such as tanks and large helicopters. Its cargo door, which is high on the side of the aircraft, limits its usefulness as a military transport, since specialized unloading equipment is required at the destination. Thus, the KC-10s are best suited to hauling bulk and certain oversize cargo to main operating bases. In this role, however, the aircraft is effective; it can transport up to 170,000 pounds of cargo (or 27 standard military pallets) for an unrefueled range of 3,800 nautical miles.

The eight KC-10As being acquired in 1987 cost about $63 million each, which is considerably less than the C-17 or the C-5B.

C-141B Starlifter

Most of the aircraft operated today by MAC are C-141Bs, four-engine long-range transports built between 1963 and 1968. The C-141B can carry 66,500 pounds of cargo over an unrefueled range of 3,000 nautical miles. The C-141B can carry a variety of bulk and oversized cargo, but cannot carry outsized cargo. It can drop cargo or parachute troops as well as transport cargo. Because of its more limited power-to-weight ratio and 1960s design, it requires considerable runway length to take off and land with a payload and is not capable of forward operations to limited airfields.

All C-141s were converted to the B model by 1982. This modification involved stretching the fuselage and increased its passenger and cargo-carrying capability. At the same time, other modifications were made to extend the service life of the aircraft structure to at least 45,000 flying hours (the C-141 fleet currently averages some 27,000 accumulated flying hours, a figure that grows by about 1,000 hours per year per aircraft). It is estimated that the C-141B airframe may be capable of up to 60,000 flight hours. CBO estimated that the costs to extend the service life to this extent would be $3 million per aircraft.

C-130 Hercules Tactical Airlifter

The C-130 Hercules had its first flight in 1954. Since then, over 1,800 aircraft have been produced by the Lockheed Corporation in a variety of models, including tankers (KC-130 and HC-130), electronic warfare (EC-130), gunship (AC-130), and special operations aircraft (MC-130). In the standard transport configuration, four models (C-130A/B/E/H) are currently in service with the U.S. Air Force. The A models (of which 113 were still in service in 1985) average 29 years of age. While some aircraft are scheduled for retirement in 1987, others are currently undergoing service-life extension programs that will enable them to continue in active service until the mid 1990s. Similarly, the B models (numbering 94 in 1985) will need to be replaced by the year 2000.

Modernized C-130Hs can carry up to 43,160 pounds of cargo or 91 troops for short distances and restricted payloads of 24,000 pounds for 3,000 nautical miles. They can carry oversized equipment, as long as it is not too heavy. The C-130H can operate on paved or unpaved runways 3,000 feet in

TABLE A-2. CHARACTERISTICS OF U.S. COMMERCIAL AIRCRAFT

Specification	707 -320C	747 -200F	DC-8 -63F	DC-10 -30CF
Dimensions (feet)				
Wingspan	146	196	148	165
Length	153	231	187	182
Height	43	64	42	58
Cargo Compartment (feet)				
Door width	11	11	11.7	11.7
Door height	7.6	10	7	8.5
Floor area (main compartment)	1,143	3,032	2,312	n.a.
Weight (thousands of pounds)				
Empty weight	140	342	152	241
Maximum gross weight	336	833	355	580
Maximum payload	60	198	83	138
Average payload a/	n.a.	146	n.a.	83
Performance				
2,500 nm. (nautical miles)				
Block speed (knots)	440	450	440	445
Range (nm.)	4,100	3,700	2,800	3,100
Objective utilization rate	10.0	10.0	10.0	10.0
Runway Length (feet) b/				
Takeoff	10,400	10,500	10,450	10,700
Landing	6,250	6,900	6,600	6,320
Cargo Capabilities				
463L pallets	13	46	18	30
Oversize cargo	No	Yes	No	Yes
Outsize cargo	No	No	No	No
Airdrop	No	No	No	No
Combat offload	No	No	No	No

SOURCES: "Specifications," *Aviation Week and Space Technology* (March 10, 1986); Department of the Air Force, "Airlift Planning Factors," AFR 76-2 (February 1982): Department of the Air Force, *Airlift Master Plan* (September 1983), Table A-2.

NOTE: n.a. = not available.

a. Planning factor used in capability calculations for the *Airlift Master Plan*.

b. FAA minimums for routine peacetime operations with maximum payload. Wartime minimums have not been established.

length. It can airdrop troops or cargo and can use the low altitude parachute extraction system and combat offload techniques. The current price of the C-130H is $19.4 million.

Civil Reserve Air Fleet Aircraft

In an emergency, commercial aircraft operated by carriers that belong to the Civil Reserve Air Fleet would become available to transport military cargo. These aircraft include all-cargo or cargo-convertible versions of the Boeing 707 and 747, and the McDonnell Douglas DC-8 and DC-10. 2/ The Administration's CRAF Enhancement Program is currently adding 19 Boeing 747 aircraft to the CRAF cargo fleet by paying for modifications to allow these passenger aircraft to be converted rapidly to cargo operation.

Table A-2 (on the previous page) describes the capabilities of the various CRAF aircraft. Note that the commercial DC-10 can carry more pallets than the military KC-10--a result of the installation of the refueling boom on the latter, which limits its cargo payload space. Only the 747 and DC-10 can carry oversize cargo. Certain 747 aircraft are equipped with both a nose and side door; DC-10s have only a side door. Both aircraft require special equipment to load and unload cargo, and are restricted to main operating bases with such facilities.

2. These aircraft are capable of long-distance international cargo missions. Other aircraft, such as the Boeing 727 and 737 and the McDonnell Douglas DC-9, also belong to the CRAF cargo program and would be used for domestic or short-distance international missions in an emergency.

APPENDIX B

SENSITIVITY ANALYSIS OF TOTAL AIRLIFT COST ESTIMATES

The Congressional Budget Office calculated total airlift costs for the 1987-2016 period for the Administration's plan and three alternative plans. These costs included those for procurement of new aircraft as well as operating and support costs for all airlift aircraft in the fleet. In the case of the option for maritime prepositioning ships (Alternative III), costs include those to operate the current airlift fleet, the incremental costs to buy and operate the additional maritime prepositioning ships, plus the cost of a duplicate set of Army equipment to be placed on the ships.

Annual costs, which were expressed in constant dollars of fiscal year 1987 budget authority, were discounted at the rate of 2 percent per year. Future costs are discounted to reflect the present value of future resources and to make it easier to compare alternatives that involve different time patterns of expenditures. The 2 percent rate was chosen based on the current differential between the interest rate on long-term, risk-free securities and CBO's estimate of the current rate of inflation.

Sensitivity to the Discount Rate

To test whether its results were sensitive to the particular rate chosen, CBO discounted costs at 4 percent and also left them undiscounted. Variations within this range made no substantive difference in the results (see Table B-1). The relative ranking of the four options as to cost did not change, although the savings from the alternatives were reduced at the higher rates of discount. Lower discount rates would seem to favor the Administration's plan, since it offers long-term operating savings against higher initial costs for procurement. This effect was mitigated, however, by the fact that procurement costs for the C-17 are stretched over a much longer period than any of the alternatives (and thus are discounted more).

Sensitivity to Operation and Support Costs

As noted in Chapter III, the Air Force argues that, if C-5s were bought instead of C-17s, it would be necessary to operate them at higher rates in

peacetime. This factor would increase the cost of Alternatives I and II, which feature purchases of C-5Bs. CBO reestimated the total costs using annual operating and support (O&S) costs of $13.8 million for the C-5A and $12.7 million for the C-5B. These costs are 27 percent higher than those used by CBO in its analysis, and reflect 1,176 flying hours per aircraft per year, versus the 774 hours CBO used.

Using the higher O&S costs, Alternative I would cost $120.6 billion over the 1987-2016 period, $2.5 billion more than the Administration's plan featuring the C-17 (see Table B-2). The cost of Alternative II also increases by some $4.3 billion, although it remains well below the cost of the Administration's plan.

TABLE B-1. SENSITIVITY OF COST ESTIMATES TO THE DISCOUNT RATE

Option	Discount Rate (In percents) 0	2	4
Total Life-Cycle Costs (In billions of 1987 budget year dollars)			
Administration's Plan (Buy C-17)	150.0	118.1	96.0
Alternative I: Achieve Capability Earlier (Buy C-5/KC-10)	146.2	114.4	92.4
Alternative II: Accept a Lower Airlift Goal	125.8	98.5	79.7
Alternative III: Emphasize Maritime Prepositioning	129.1	99.7	79.7
Savings from the Administration's Plan			
Alternative I	3.8	3.7	3.6
Alternative II	24.2	19.6	16.3
Alternative III	20.9	18.4	16.3

SOURCE: Congressional Budget Office.

While this change would reverse CBO's findings that Alternative I is modestly cheaper than the Administration's proposal, it would not alter the fact that Alternative I offers a six-year improvement in meeting the inter-theater airlift goal, at a cost comparable to the Administration's proposals.

The Uncertainty of Procurement Costs

The costs of the full C-17 program are still estimates. The C-5 costs, by contrast, are based on a firm offer. Historically, DoD's track record in procuring major weapon systems would tend to suggest a higher risk that the

TABLE B-2. SENSITIVITY OF COST ESTIMATES TO C-5 PEACETIME OPERATING RATE

Option	C-5 Peacetime Flying Hours (Per aircraft per year) 774	1,176
Total Life-Cycle Costs (In billions of 1987 budget year dollars)		
Administration's Plan (Buy C-17)	118.1	a/
Alternative I: Achieve Capability Earlier (Buy C-5/KC-10)	114.4	120.6
Alternative II: Accept a Lower Airlift Goal	98.5	102.8
Alternative III: Emphasize Maritime Prepositioning	99.7	b/

SOURCE: Congressional Budget Office.

a. Because of the C-17 flying hour program, it would not be necessary to operate the C-5B at the higher rate in the Administration's plan.

b. As long as C-141Bs were maintained at a ratio of four crew members per plane, it would not be necessary to increase the C-5B flying rate under this alternative plan.

C-17's cost will grow. This factor would increase the savings from the alternatives.

On the other hand, in recent years, programs have shown much less unanticipated cost growth than was true in the 1970s. Most recently, the total estimated cost of programs listed in the Selected Acquisition Report actually declined by about 6 percent (although most of this decline resulted from a bookkeeping change related to lower assumptions for inflation).

Furthermore, the C-17 program offers less technical risk than the average DoD development program, since many features of the aircraft were demonstrated on the YC-15 prototype or elsewhere. As a result, CBO found no reason to question the U.S. Air Force's cost estimate of $29.3 billion to complete the C-17 program.

63-666 (72)

CONGRESSIONAL
BUDGET OFFICE
Second and D Streets, S.W.
Washington, D.C. 20515

FIRST-CLASS MAIL
POSTAGE & FEES PAID
C.B.O.
PERMIT No. G-70

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300